ENVIRON

ECOLOGICAL RISK SCREENING EVALUATION
Remedial Investigation/Feasibility Study
Eagle Zinc Company Site
Hillsboro, Illinois

Submitted to:

U.S. Environmental Protection Agency, Region 5
and
Illinois Environmental Protection Agency

Submitted by:

ENVIRON International Corporation
Deerfield, Illinois

On behalf of:

Eagle Zinc Parties

August 2004

ENVIRON

August 19, 2004

Mr. Dion Novak
Superfund Division
United States Environmental Protection Agency
77 West Jackson Boulevard
Mail Code: SR-6J
Chicago, IL 60604

Re: Ecological Risk Screening Evaluation
Remedial Investigation/Feasibility Study
Eagle Zinc Company Site, Hillsboro, Illinois

Dear Mr. Novak:

Enclosed please find the report entitled *Ecological Risk Screening* Evaluation for the Eagle Zinc Company Site and a compact disk containing the report.

If you have any questions concerning this submission, please do not hesitate to contact us.

Sincerely,

ENVIRON International Corporation

F. Ross Jones

F. Ross Jones, P.G.
Manager

FRJ:rms
R \Client Project Files\Eagle Zinc-Hillsboro_21-7400E\Risk Assessment\SLERA_2004\ECO Risk Screening_2004\ERSE transm ltr_081904 doc

Enclosures

cc: Thomas Krueger, Esq. – USEPA Region 5
Rick Lanham – IEPA Bureau of Land
Chris English – CH2M Hill
John Ix, Esq. – Dechert
Lois Kimbol, Esq. – Dechert
Paul Harper – Eagle-Picher
Gordon Kuntz – Sherwin-Williams
Roy Ball – ENVIRON
Jeff Margolin – ENVIRON

Ecological Risk Screening Evaluation for the Eagle Zinc Company Site

Prepared by:

ENVIRON

August 2004

Prepared by:

Paige Leitman, Ph.D.
Senior Associate

Mary Sorensen, C.E.
Senior Science Advisor

Jeff Margolin, R.H.S.P
Principal

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS

BERA	Baseline ecological risk assessment
°C	Celsius
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, Liability Information System
COPCs	Constituents of potential concern
CSM	Conceptual Site Model
EPC	Exposure point concentration
ERA	Ecological risk assessment
ESI	Environmental Site Investigation
ESV	Ecotoxicity Screening Value
HQ	Hazard quotient
IEPA	Illinois Environmental Protection Agency
ILDNR	Illinois Department of Natural Resources
IWPC	Illinois Water Pollution Control
LOAEL	Lowest Observed Adverse Effects Level
NOAA	National Oceanographic and Atmospheric Administration
NOAEL	No Observed Adverse Effects Level
NPDES	National Pollution Discharge Elimination System
NRWQC	National Recommended Water Quality Criteria
NWI	National Wetlands Inventory
PEL	Permissible Exposure Limit
PSER	Preliminary Site Evaluation Report
OME	Ontario Ministry of the Environment
RI/FS	Remedial Investigation/Feasibility Study
RSI	Risk Sciences International
SLERA	Screening-level ecological risk assessment
SEL	Severe Effects Level
SMDP	Scientific management decision point
T&E	Threatened and Endangered
TEL	Threshold Effects Level
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
VOCs	Volatile organic compounds
XRF	X-ray Fluorescence

EXECUTIVE SUMMARY

This report presents the ecological risk screening evaluation for the Eagle Zinc Site in Hillsboro, Illinois. The evaluation is consistent with previous work products and work plans for the Site, and with current USEPA guidance for conducting ecological risk assessments. The evaluation consists of three primary elements, a screening-level ecological risk assessment (SLERA), a baseline ecological risk assessment (BERA), and conclusions (called a scientific management decision point).

The SLERA portion of the evaluation assessed the risks to wildlife that may be exposed to Site-related constituents in the surface water, sediment, and soil at and near the Site. The wildlife that was assessed in the SLERA were aquatic wildlife, fish-eating wildlife (piscivores), and terrestrial wildlife. As required in a screening level assessment, the assessment of risks was conducted in a very conservative (i.e., protective) manner for each medium/wildlife combination. The outcome of the SLERA was that no significant risk was predicted for some of the medium/wildlife combinations, while others needed further evaluation. Consistent with USEPA guidance, these medium/wildlife combinations that needed further evaluation were carried forward into the BERA.

The BERA portion of the evaluation assessed the potential risks that were not "screened out" in the SLERA, but evaluated them in a less conservative but still protective manner. Specifically consistent with USEPA guidance, the risk estimates took into account more realistic exposure and toxicity information. This means that the BERA (unlike the SLERA) did not assume consistent exposures to maximum concentrations detected at the Site, or that wildlife receptors would spend their entire lives in one location or that any predicted effect would be unacceptable. The outcome of the BERA was that there may be small, localized areas on and off Site at which adverse impacts to some wildlife may occur. However, these locations are localized to small areas and often in areas with otherwise poor habitat. Therefore, the adverse impacts are likely negligible (if they are occurring at all). This finding is supported by the information and analytical data developed for the Site, as well as by biologists and ecologists that visited the Site and were involved in the ecological risk screening evaluation.

Therefore, the scientific management decision point (i.e., the conclusion) is as follows: Based on this information, the few exposure scenarios where adverse impacts are predicted are not indicative of ecologically significant impacts to populations, communities, or ecosystems (a primary risk management consideration according to USEPA [1999]). Therefore, it is concluded that the available information is adequate to decide that ecological risks are negligible at the Eagle Zinc Site and that there is no need for further action on the basis of ecological risk.

1.0 INTRODUCTION

This report presents the ecological risk screening evaluation for the Eagle Zinc Site (the Site), located in the Township of Hillsboro, central Montgomery County, Illinois. This section provides overview of the following: (1) the ecological risk screening approach presented in this report, (2) the regulatory history of the Site; and (3) the organization of the remainder of this report.

1.1 Ecological Risk Screening Approach

The ecological risk screening presented herein was conducted in a manner consistent with the Eagle Zinc Remedial Investigation/Feasibility Study (RI/FS) Work Plan (ENVIRON 2002a; Appendix D: Baseline Risk Assessment Plan) as well as with appropriate United States Environmental Protection Agency (USEPA) ecological risk assessment (ERA) guidance (e.g., USEPA 1997; 1998; 2000a; 2001a). The ecological risk screening evaluation conducted for the Eagle Zinc Site includes the following steps, as described in the Eagle Zinc Baseline Risk Assessment Plan (ENVIRON, 2002a):

- Step 1: Screening-level Problem Formulation and Ecological Effects Evaluation
- Step 2: Screening-level Preliminary Exposure Estimate and Risk Calculation
- Step 3: Problem Formulation

These three steps are components of the USEPA 8-Step ERA process, as illustrated on Figures 1-1 and 1-2. Steps 1 and 2 comprise the screening-level ecological risk assessment (SLERA), while Step 3 is the initial step of the baseline ecological risk assessment (BERA) (USEPA 1997; 2000a). A SLERA evaluates the potential risk to wildlife exposed to chemical constituents by providing a conservative estimate of the risks that may exist for wildlife, and incorporating uncertainty in a precautionary (i.e., conservative) manner. The purpose of a SLERA is to either indicate that there is a high probability that there are no ecologically significant risks for wildlife, or to indicate the need for additional consideration (USEPA, 1997; 2000a). Additional consideration may include additional chemical investigation, reevaluation of the SLERA, remedial action for reasons other than ecological risks, or a BERA (in which case the information developed in the SLERA is used to help focus the BERA). A BERA is more complex than a SLERA and typically incorporates more realistic wildlife exposure information. Only those wildlife receptors (and particular constituents) identified with potential risks in the SLERA are carried forward in a BERA.

Step 3 of the ERA process (i.e., Problem Formulation) is an opportunity for iterative refinement of potential risks using methods similar to those used in Steps 1 and 2 (USEPA 2000a; 2001b), as illustrated on Figure 1-2. Specifically, constituents of potential concern (COPCs) identified in the SLERA may be eliminated from further consideration based on the refinement of certain assumptions, such as reasonable chemical exposure estimates, background/reference location comparisons, and consideration of more realistic bioaccumulation potential. According to the USEPA (2000a):

> *"The Problem Formulation [i.e., Step 3] is commonly thought of in two parts: Step 3a and Step 3b. Step 3a serves to introduce information to refine the risk estimates from steps one and two. For the majority of Sites, ecological risk assessment activities will cease after completion of step 3a. At many Sites, a single deliverable document consisting of the reporting of results from steps 1, 2 and 3a may be submitted. At those Sites with greater ecological concerns, the additional problem formulation is called Step 3b. It is very important at this stage to perform a 'reality check.' Sites that do not warrant further study should not be carried forward."*

The use of Steps 1, 2, and, as necessary, 3a/3b for the evaluation of ecological risks at the Eagle Zinc Site was agreed upon in the RI/FS Work Plan (ENVIRON, 2002a), and reconfirmed during the stakeholder meeting of June 2, 2004. This meeting was attended by representatives of the responsible parties and their contractors, and the USEPA and its contractors. Technical issues discussed during the June 2nd meeting were summarized in a Technical Memorandum, dated June 7, 2004 (CH2MHill, 2004), and subsequent correspondence in response to USEPA's comments on the Draft Ecological Risk Screening Report (ENVIRON 2004).

The ERA process produces a series of clearly defined scientific management decision points (SMDPs), as illustrated on Figures 1-1 and 1-2 (USEPA 1997; 2000a). The SMDPs represent critical steps in the process where ecological risk management decision-making occurs. Stakeholder meetings and project-specific communication about ecological risk assessment approaches (such as the meetings and correspondence described above) are beneficial in the identification and acceptance of the ERA methodologies used and, ultimately, the SMDPs. Generally, the following types of decisions are considered at the SMDPs:

- Whether the available information is adequate to conclude that ecological risks are negligible and, therefore, there is no need for any further action on the basis of ecological risk.
- Whether the available information is not adequate to make a decision at this point, and the ecological risk assessment process will continue.
- Whether the available information indicates a potential for adverse ecological effects, and a more thorough assessment or remediation is warranted.

1.2 Site Regulatory History

Zinc processing operations began in 1912, at which time the facility operated as a zinc smelter under the name Lanyon Zinc Company. Smelting products included zinc and sulfuric acid. In 1919, the Site was purchased by Eagle Picher Industries, which continued the zinc smelting and sulfuric acid manufacturing operations. Sometime after 1919, zinc oxide and leaded zinc oxide production commenced at the Site. The leaded zinc oxide production ceased in approximately 1958, though Eagle Picher continued to manufacture zinc oxide at the Site until November 1980. At that time, Sherwin-Williams purchased the Site and continued manufacturing operations for less than one year. In 1984, the facility was sold to Eagle Zinc Company (now a division of T.L. Diamond). The Eagle Zinc Company primarily manufactured zinc oxide at the Site. Manufacturing operations permanently ceased at the Site at end of 2002 (ENVIRON 2003a).

The Site was initially listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) on June 1, 1981, following a discovery action initiated during Site ownership by Sherwin-Williams. Sherwin-Williams notified USEPA that the Hillsboro Site qualified as a Hazardous Waste Site, in accordance with Section 103(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly referred to as Superfund). Pursuant to this action, the Illinois Environmental Protection (IEPA) conducted several Site investigations under Superfund. On May 22, 1998, Eagle Zinc entered into an Interim Consent Order, with the Illinois Attorney General and the IEPA (ENVIRON 2002a&b). All issues associated with the Interim Consent Order were resolved in the final Consent Order, dated January 7, 2002.

An RI/FS is being performed for the Site in accordance with the December 31, 2001, Administrative Order on Consent between the Parties and the USEPA. As stated in the RI/FS Work

Plan (ENVIRON 2002a), the primary focus of the RI is to characterize the nature and extent of releases at the Site, to assess potential migration pathways by which the Site-related chemicals could impact humans or ecological receptors, and to evaluate potential risks to those receptors. The following reports have been submitted:

- A Preliminary Site Evaluation Report (PSER) was submitted to the USEPA Region V and IEPA in March 2002 (ENVIRON 2002b). The PSER provides an overview of the Site and its history (operational and regulatory), as well as an evaluation of existing data. The PSER also provides an evaluation of soil, sediment, residue, surface water, and ground water data available at that time and presents a list of potential chemicals of concern for each medium, based on available data. Potential on Site and off Site exposure routes are also identified in the PSER.
- The Phase 1 Technical Memorandum (ENVIRON 2003a) discusses the Phase 1 remedial investigation activities that were conducted in July 2002, including the surveying and soil, sediment, and residue investigations. Also included in the Phase 1 Technical Memorandum is a discussion of the nature and extent of contamination, based on an analysis of the soil, sediment, and residue sampling results. The Phase 1 Technical Memorandum includes a modified Site conceptual model, with the soil, sediment, and residue information modified based on the Phase 1 sampling data for these media. The Phase 2 sampling program is previewed in the Phase 1 Technical Memorandum.
- The Phase 2 Technical Memorandum (ENVIRON 2003b) discusses the Phase 2 remedial investigation activities that were conducted in March and June 2003, including monitoring well and piezometer installation, water level measurement, ground water sampling, surface water sampling, supplementary residue sampling, and soil pH sampling. The Phase 2 Technical Memorandum includes an updated Site conceptual model with the ground water, surface water, and residue information modified based on the Phase 2 results. In November 2003, additional surface water and sediment samples were collected from on Site portions of the Western Drainage Area for analysis of volatile organic compounds (VOCs). The sampling results were transmitted to the USEPA with the January and February 2004 monthly progress reports.

1.3 Report Organization

The remainder of this report is organized as follows:

- Section 2.0 Step 1: Screening-Level Problem Formulation and Ecological Effects Evaluation
- Section 3.0 Step 2: Screening-Level Exposure Estimate and Risk Calculation
- Section 4.0 Step 3a: Refinement of Step 2 Screening-Level ERA Exposure Estimates and Risk Calculations (Baseline ERA Problem Formulation)

2.0 STEP 1: SCREENING-LEVEL PROBLEM FORMULATION AND ECOLOGICAL EFFECTS EVALUATION

Step 1 of the SLERA involves the screening-level problem formulation and ecological effects evaluation. Step 1 is presented in Section 2.1 (screening-level problem formulation) and Section 2.2 (screening-level ecological effects evaluation).

2.1 Screening-Level Problem Formulation

The overall purpose of the screening-level problem formulation is to describe the environmental setting on the Site (hereafter referred to as "on Site") and adjacent to the Site (hereafter described as "off Site"), and to provide a preliminary evaluation of ecological exposure pathways and assessment endpoints. The screening-level problem formulation serves to define the reasons for the SLERA and the methods for analyzing/characterizing risks (USEPA 1998). Information pertaining to Site characterization, potential receptors, and ecosystem characteristics is vital to the problem formulation, as is information on the sources and effects of the stressors (USEPA 1998). The screening-level problem formulation provides information used to establish the overall goals, breadth, and focus of an ERA (USEPA 1997; 1998). Once these are established, the problem formulation is used to develop a conceptual model for the ERA.

The screening-level problem formulation produces two outputs: 1) assessment endpoints that reflect the management and ecosystem attributes the endpoints are meant to protect; and 2) a conceptual Site model that describes the relationships between stressors and the assessment endpoints.

The remainder of this section presents the following components of the screening-level problem formulation for the Site:

- Environmental Setting
- Identification of Constituents Detected and Classification of Sediments
- Description of Constituent Fate and Transport Pathways
- Description of Constituent Mechanisms of Ecotoxicity

- Description of Potentially Exposed Receptors
- Identification of Potentially Complete Exposure Pathways
- Identification of Generic Assessment and Measurement Endpoints

2.1.1 Environmental Setting

The Eagle Zinc Site is located in the Township of Hillsboro, central Montgomery County, Illinois (Figure 2-1). The Site is approximately 132 acres in area in a mixed commercial/industrial and residential area east of Hillsboro. The Site was in continuous industrial use for 90 years (from 1912 until 2002). Operations at the Site included zinc smelting, and manufacture of sulfuric acid, metallic zinc, zinc oxide, and leaded zinc oxide. Activities on the Site had been declining over the past several years as industrial operations slowed down, and finally ceased in 2002. This decreasing human activity level allowed slow reclamation of physically disturbed areas by common opportunistic species. However, there are still large areas with sufficient physical alteration to provide little wildlife habitat, such as manufacturing and other process-related areas that offer little or no vegetative cover. This section describes:

1. On Site industrial areas
2. On Site and off Site non-industrial areas
3. Off Site adjacent land use

The characterization of the environmental setting is based on field surveys by qualified environmental biologists and a Certified Ecologist. Field surveys were conducted on July 15, 2002, March 3, 2004, and June 22, 2004. The information used to develop this environmental setting is provided in Appendix A, as follows, with a narrative discussion provided in the remainder of this section:

- Appendix A-1: USEPA Ecological Characterization Worksheet (1997) – This worksheet documents the habitat on Site and in the vicinity of the Site.
- Appendix A-2: A summary of species or sign observed during field surveys – The summary of species or sign documents that wildlife is present on Site (and the observations described in Section 2.1.1 provide insight into the wildlife use of the Site, as well as allows for generalizations about the types of wildlife receptors that are likely to be exposed at the Site).

- Appendix A-3: List of sensitive species/habitats in USEPA's Hazard Ranking System – Based on observations from several field surveys, it was determined that sensitive habitats, as defined in USEPA guidance (1997), are not present at the Site (except for limited examples of man-made wetlands).
- Appendix A-4: Correspondence with Illinois Department of Natural Resources (ILDNR) personnel regarding threatened and endangered (T&E) species – The presence/absence of T&E species was explicitly evaluated in consultation with ILDNR. This appendix documents correspondence on this matter. Specifically, the representative of the ILDNR concluded that, "according to the Illinois Natural Heritage Database, there are no endangered or threatened species within the Site area indicated, specifically Township 8 North, Range 4 West, Sections 1 & 12, Third Principal Meridian. Nor are there any listed species within 1 mile of the project Site boundaries."
- Appendix A-5: Photographs documenting Site conditions – A broad range of photographs are provided as part of the characterization of the Site (Photographs A-5a through A-5bb). These photographs are referenced throughout Section 2.1.1 to illustrate specific features relevant to this ecological risk screening.

2.1.1.1 On Site Industrial Areas

During nearly a century of Site operations, approximately 25 percent to 30 percent of the Site (or approximately 30 to 40 acres) was developed into and/or used for manufacturing areas, residue storage areas, raw material storage areas, railroad sidings, and paved/unpaved roadways (Figure 2-2). As is typical with the development of industrial properties, the use of the property involved the physical elimination of potential ecological habitat (e.g., clearing of land, construction of buildings, paving of roads, installation of railways). Currently, operations have ceased at the Site, but the physical structures remain (e.g., Photographs A-5a, A-5b, and A-5c). There are no plans for the restoration of functional habitat within the industrialized areas of the Site because redevelopment of the Site with continued industrial land use is planned.

2.1.1.2 On Site and Off Site Non-Industrial Areas

Current wildlife habitat and biological resources are present on Site in areas that are outside the former manufacturing area and residue storage areas. It is estimated that approximately 70 to 75 percent of the Site has some form of wildlife habitat; however, much of the on Site habitat is limited due to physical alteration from human land use (e.g., old fields previously landscaped, old fields previously used for agricultural purposes, and man-made aquatic structures). The following subsections describe the habitat that is present on and off Site.

2.1.1.2.1 Terrestrial Habitat

As indicated on Figure 2-3, the terrestrial habitat on Site and in proximity to the Site includes woods, old fields, mixed woods, and grasses. The terrestrial habitats on Site are not considered sensitive habitats under the USEPA Hazard Ranking System (1997; Appendix A-3). Terrestrial habitats on Site are similar to those available in the surrounding area (the surrounding area will be described in greater detail in Section 2.1.1.3). Terrestrial habitats are shown in Appendix A-5 (Photographs A-5d through A-5l; note that terrestrial habitat can also be seen along drainages in other photographs as well). Habitats such as these can support terrestrial wildlife, such as birds, mammals, and herpetofauna (i.e., reptiles and amphibians).

Open Field Habitat

Terrestrial areas, such as the open field present in the northern area (Figure 2-3 and Photographs A-5k and A-5l), provide cover and wildlife habitat, yet there are indications of physical impacts due to previous land use. The old field habitat in the northern section of the Site was previously used for agricultural purposes. This type of habitat will progress through natural successional changes if not maintained. Young successional woody species (and in some areas, wetland grass species) were observed in June 2004, suggesting a relatively recent change in management strategy allowing the woody species to colonize. The old field habitat to the west of the manufacturing area was also maintained in some manner during Site operations, as evidenced by the fact that significant successional changes to the woodlands were not obvious as recently as June 2003.

Mixed Woods and Woodland Habitats

Mixed woods and woodland habitat also provide habitat and cover away from the manufacturing and open residue areas. For example, trees adjacent to drainages provide diverse habitat (Figure 2-3 and Photographs A-5m through A-5y). Specifically, trees in the mixed woods are generally about 10 to 15 years old (Photographs A-5q through A-5t), while in the woodlands some trees are apparently much older. Songbirds, including northern cardinal, were heard and observed in the mixed woods and woodlands.

Physical Alteration to Habitat: Catalpa Trees

Although terrestrial wildlife habitat is present on Site, it is limited in areas due to the physical alteration of habitat. For example, it has been previously noted that stands with dead catalpa (*Catalpa speciosa*) trees are in close proximity to the manufacturing area (north/northwest). Dead trees were reportedly observed in the late 1980s, and at other occasions since that time, including 2004. A Certified Ecologist conducted a field survey in June 2004, with particular attention given to the dead catalpas. Based on the field survey and a review of relevant literature, there is sufficient evidence to suggest that the mortality of the catalpa is not directly related to elevated chemical residues because:

- Dead trees were observed at the northern extreme of the Site, away from areas impacted by the Site.
- Apparently robust saplings were observed growing in residue material.
- Dead trees were collocated with hydric soils atypical of the species preferred habitats.
- Recent succession to *Salix* species (i.e., willows, which are a hydrophilic species) was noted in areas with inundation.
- Catalpa's natural resistance to degradation could allow tree remnants to accumulate, giving the appearance of widespread mortality.

In areas with many dead catalpa trees, there is current evidence of all stages of tree health (i.e., some are healthy, some are dying, others have clearly been dead for some time). Photographs of these trees can be seen in Appendix A-5 (Photographs A-5d through A-5h). It was discovered during the field survey that dead catalpa trees were also present off Site, as well as at the northern extreme of the Site (i.e., away from areas impacted by Site operations, Photograph A-5i). In addition, it was noted that apparently robust catalpa saplings are growing from residue material on Site (Photograph A-5j). In areas on Site and off Site where dead trees were observed, significant inundation of soil was also observed (see Photograph A-5e). It is not clear whether the inundation is due to prolonged or episodic flooding of the area, but it is known that catalpa are facultative upland plants (i.e., they are found in upland habitats 70 percent to 99 percent of the time) (U.S. Department of Agriculture 2004). Further evidence of transitional conditions is the apparent succession toward water tolerant species, such as willow (*Salix* sp.), as shown in Photographs A-5g and A-5h. It has been unclear whether the mortality of these trees was due to physical or chemical stressors. Furthermore, the actual length of time over which mortality occurred is unknown, but it is known that catalpa wood is very resistant to degradation. In fact, farmers introduced Northern Catalpa in order to produce large amounts of relatively lightweight timber for fence posts, since the wood is very resistant to rotting (Ohio Department of Natural Resources 2004). This resistance to degradation is likely contributing to the accumulation of tree remnants.

2.1.1.2.2 Aquatic Habitat

There are two primary drainage systems that receive and convey flow from the Site, as shown in Figure 2-4: the Eastern Drainage and Western Drainage. The Eastern and Western Drainages are described in the following subsections, including a description of flow direction as well as the on Site and off Site aquatic habitats associated with the drainages.

There is also one small aquatic feature that is not categorized as being part of the Eastern or Western Drainage, thus it is described very briefly here. This aquatic feature is a very small retention pond located immediately south of the manufacturing area (Figure 2-2 and 2-3). This pond has been identified as "intermittently exposed palustrine wetlands with unconsolidated materials in diked or impounded areas" on the National Wetland Inventory (NWI) Map for Hillsboro, Illinois (U.S. Fish & Wildlife Service, 1988). As can be seen on Figure 2-2, railroad spurs create a narrow corridor where one would expect water movement to be constrained. There is no apparent outflow from the small pond, and inflow appears to be via overland runoff (channels were dry at the time of the July 2002, March 2004, and June 2004 visits). In July 2002, basking turtles were observed in the east end of the pond, as well as dragonflies and frogs. Floating algal mats in the pond were also noted.

<u>**Eastern Drainage Area**</u>

The Eastern Drainage enters the Site from the north and drains the northeastern corner of the Site. Drainage from the northern wooded area (Figures 2-3 and 2-4) flows via an undefined channel/marshy area near the origination points (e.g., illustrated in Photograph A-5e), and flows via a more defined natural channel near the stormwater ponds and the eastern boundary of the Site. The Eastern Drainage also conveys outflow from two man-made stormwater retention ponds. The stormwater retention ponds receive drainage from the manufacturing area, as seen on Figures 2-2, 2-3, and 2-4. The tributaries comprising the Eastern Drainage converge near the eastern Site boundary and flow east/northeast approximately ½ mile to Lake Hillsboro (Figures 2-3 and 2-4).

Flow via the stormwater retention ponds was previously managed via an IEPA National Pollutant Discharge Elimination System (NPDES) Permit. In May 2003, the IEPA terminated the Site's NPDES Permit. The permit was terminated because, according to the IEPA's May 23, 2003 Public Notice/Fact Sheet of Intent to Terminate NPDES Permit No. IL0074519, "...the facility has closed, all industrial activity has ceased, and the discharges have ceased."

On Site Eastern Drainage Aquatic Habitat

Aquatic habitat in the on Site portion of the Eastern Drainage is very limited, even dry at times (such as during the July 2002 field survey and during sampling in 2003). Although on Site areas of the Eastern Drainage were observed to be inundated during the June 2004 field survey (as seen in Photographs A-5e, A-5f, and A-5g), even when wet the limited aquatic habitat is not sufficient to support fish, or piscivorous (fish eating) species. Habitat in the stormwater retention ponds is also limited, as the ponds are composed of a small concrete settlement structure and a two-cell, clay-lined retention pond installed in 2001. Water levels in the stormwater retention ponds have been observed to fluctuate between one foot (July 2002) and several feet (March 2004/June 2004). Algal blooms and frogs were observed in the ponds during the July 2002 and June 2004 field surveys; however, the stormwater retention ponds do not provide suitable habitat for fish or piscivorous wildlife.

Off Site Eastern Drainage Aquatic Habitat

Aquatic habitat in the off Site Eastern Drainage (Photograph A-5m) is of slightly higher quality than habitat on Site because there are small pools that may provide more stable and lasting aquatic habitat (though these pools are not perennial in the vicinity of the Site, it is likely that perennial pools exist as flow approaches Lake Hillsboro). Very small fish (centrarchids), damselflies, crayfish burrows, and sunfish were observed in a small pool in the vicinity of Lake Hillsboro in July 2002. Lake Hillsboro, a manmade reservoir approximately ½-mile east of the Site (Photograph A-5n) provides diverse aquatic habitat. Fish and piscivorous wildlife are likely to be present in the lake.

Western Drainage Area

The Western Drainage originates on Site near the manufacturing area, flows in a southwesterly direction into a stormwater retention pond, and ultimately flows off Site via an outfall to an unnamed drainage (Figure 2-3 and 2-4). The stormwater retention pond outfall was previously managed under the same NPDES permit mentioned for the Eastern Drainage (cancellation of the permit in 2003 applied to both outfalls). Flow from the stormwater pond merges with flow from another unnamed drainage (this one south of the Site), and this joined drainage feature flows westerly until its confluence with an unnamed tributary that ultimately flows northward toward Middle Fork Shoal Creek (approximately one mile from the Site).

On Site Western Drainage Aquatic Habitat

The origin of the on Site Western Drainage is a small ditch in the western portion of the Site (Photograph A-5c). The Western Drainage flows through a small man-made wetland area (Photograph A-5u) dominated by common reeds (*Phragmites australis*) and juncus (*Juncus acuminatus*) to its accumulation in the stormwater retention pond. On Site Western Drainage habitat in the stormwater retention pond is perennial and sufficient to support aquatic wildlife, such as small fish, turtles, frogs, and piscivorous wildlife (Photographs A-5o through A-5u). The pond is mapped as "intermittently exposed palustrine wetlands with unconsolidated materials in diked or impounded areas" on the USFWS NWI Maps (USFWS 1988). Albeit limited in size, the approximately one acre stormwater retention pond provides the most significant aquatic habitat on Site because the presence of water is perennial and vegetative cover is available (both macrophytes and adjacent willow canopy). However, this aquatic feature is man made. Water enters the pond via a swale and residue-covered berms form the pond basin (to the north, west and south). Residue material, broken concrete, and other items currently constrict the outfall.

In March and June 2004, no flow from the outfall of the pond to the stream was observed, but seepage from the berm was noted, as well as evidence of overland flow (dry at the time of the July 2002 Site visit) to the stream. Photographs A-5o through A-5s show the pond at various times and seasons. Floating algal mats and pondweed were observed in the pond, and this vegetation provides habitat cover for fish, aquatic organisms, and amphibians. Dragonflies were observed in this area in July, and numerous fish (including fathead minnows [*Pimephales promelas*], common shiner [*Luxilus cornutus*], and green sunfish [*Lemomis cyanellus*]) were seen in the pond. Two green herons (*Butorides virescens*) were observed feeding at its upstream end. Aside from the stormwater pond, very little aquatic habitat exists within the on Site Western Drainage area.

Off Site Western Drainage Habitat

Water flows off Site via an unnamed drainage to its confluence with an unnamed tributary, ultimately flowing due north via the unnamed tributary to Middle Fork Shoal Creek (approximately 1 mile from the Site). Immediately off Site in the Western Drainage, habitat is again very limited due to high and low water cycles (Photographs A-5t and A-5v). For example, the drainage south of the Site (Figure 2-3) was dry at the time of the July 2002 visit, but there was very shallow flowing water in March 2004 and June 2004. The off Site Western Drainage (south of the Site) also appeared to have limited habitat due to heavy siltation (e.g., Photograph A-5w), with possible contributions from an adjacent facility (a concrete plant) to the south. Nevertheless, in March 2004, filamentous algae in this habitat were widespread (Photograph A-5w), but no other aquatic life was noted. In June 2004, small fish and aquatic insects were observed in this drainage feature. Discarded plywood and other debris were also observed.

As drainage flows westerly away from the Site, the unnamed drainage passes through residential areas until its confluence with the unnamed tributary. The habitat in the unnamed drainage is very limited and does not support fish habitat on a perennial basis (Photographs A-5x). Habitat quality increases as flow volume increases in the unnamed tributary that flows north to Middle Fork Shoal Creek (Figures 2-3 and 2-4). In these higher volume flows off Site in the Western Drainage (i.e., in the unnamed tributary), more diverse and perennial supporting aquatic habitat is present (PhotographA-5y). These areas also support greater canopy cover and riparian habitat (which provides a buffer to the aquatic habitat). For example, nettles (*Urtica dioica*), common reeds (*P. australis*), and juncus (*Juncus acuminatus*) were observed in the creek floodplain. Wildlife observations included whitetail deer tracks, raccoon tracks, turtle burrows, frogs, crayfish holes, and an eastern box turtle in a creek burrow.

2.1.1.3 Off Site Adjacent Land Use

The land use context in which a Site is located is relevant in an ERA for understanding potential influences of a Site relative to other stressors. The land use adjacent to the Site is also characterized by intensive human land use, with a number of commercial/industrial facilities in the immediate vicinity (Figure 2-2 and 2-3):

- North: Small facility, Hayes Abrasives; golf course; agricultural fields
- South: Small commercial/industrial facilities, including University of Illinois Extension office; Fuller Brothers Construction/Ready Mix; Hixson Lumber; Hillsboro Rental; Vogel Plumbing

- East: Industrial Drive; an asphalt company; a railroad corridor; former Hillsboro Glass Company facility (now a steel warehouse), and a densely wooded drainage corridor that leads to Lake Hillsboro
- West: Undeveloped land and a residential area containing single- and multi-family dwellings

In addition to the intensive human use just discussed, natural areas that form a habitat mosaic must also be considered. A close evaluation of Figure 2-3 shows aerial imagery of the area surrounding the Site (i.e., areas outside the habitat characterization used for the Site). As can be seen on Figure 2-3, and was observed during the field surveys in July 2002, March 2004, and June 2004, *the aquatic and terrestrial habitat on Site is part of a much larger landscape mosaic.* For example, along the off Site Eastern Drainage, dense riparian woodlands leading to Lake Hillsboro can be seen in the aerial imagery. Similarly, to the northwest of the Site, woodlands can be seen along the off Site Western Drainage. Also, though not shown on Figure 2-3, the Bremer Sanctuary, located just 1 mile north of Hillsboro, provides more than 200 acres of oak-hickory upland and 40 acres of grasslands.

2.1.2 Identification of Constituents Detected and Classification of Sediments

This section presents a summary of constituents detected in surface water, sediment, and soil. In addition, the classification of sediments is provided for sieved sediments using IEPA's Evaluation of Illinois Sieved Stream Sediment Data (IEPA, 1997) and unsieved sediments in Illinois, using data developed by Kelly and Hite (1984).

2.1.2.1 Occurrence of Constituents Detected

This section discusses the constituents detected in the on Site and off Site surface water, on Site and off Site sediment, and on Site soil. The analytical data obtained during the RI (ENVIRON 2003a&b) were used to identify constituents on Site and off Site. The analytical data for each medium is presented in Appendix B, with sample locations identified on Figures 2-5a, 2-5b, and 2-5c, for surface water, sediment, and soil (respectively). The data were compiled into on Site and off Site groupings as part of the SLERA evaluation, as indicated on Table C-1, with on Site and off Site summaries provided by medium in Tables C-2 through C-4. The following summaries of the constituents that were detected are provided in Appendix C:

- Table C-2a: Occurrence of Constituents in Surface Water (On Site)
- Table C-2b: Occurrence of Constituents in Surface Water (Off Site)
- Table C-3a: Occurrence of Constituents in Sediment (On Site)
- Table C-3b: Occurrence of Constituents in Sediment (Off Site)
- Table C-4: Occurrence of Constituents in Surface Soil (On Site)

In keeping with the conservative nature of a SLERA, maximum detected chemical concentrations identified from Tables C-2 through C-4 are used in this SLERA (USEPA, 2000a, 2001a). The tables presented in Appendix C also identify the constituents detected, the frequency of detection, the range of sample quantitation limits, the range of detected concentrations, the 95 percent upper confidence limits (UCLs), and exposure point concentrations (EPCs). The EPC is the lesser of the maximum detected concentration or the UCL for each constituent. The UCLs were calculated assuming lognormal distributions (Gilbert 1987).

The surface water and sediment sampling program involved characterization of conditions on Site and off Site, as identified on Figures 2-5a and 2-5b, respectively. Inorganic constituents (metals and sulfate) as well as volatile organic compounds (VOCs) were detected in each medium, as follows:

- On Site Surface Water (Table C-2a): 15 inorganic constituents, 2 VOCs
- Off Site Surface Water (Table C-2b): 23 inorganic constituents
- On Site Sediment (Table C-3a): 21 inorganic constituents, 6 VOCs
- Off Site Sediment (Table C-3b): 21 inorganic constituents

The on-Site soil sampling program involved collection of surface soil samples (i.e., samples from approximately 0-2 feet below ground surface [bgs]) and samples from 0-2 feet below residue materials (Figure 2-5c). On Site soil X-ray fluorescence (XRF) screening results were used to select soil samples to be retained for target metals analysis. As indicated on Table C-4, 23 metals were detected in soil.

2.1.2.2 Classification of Sediments

This section presents the classification of on Site and off Site sediments using sieved and unsieved classification categories available for Illinois (IEPA 1997; Kelly and Hite 1984). This analysis is provided at USEPA request. The intent of this classification is to have a means of identifying sediments that contain inorganic constituents at concentrations that are elevated above typical levels in Illinois, and to compare recent data to historical unsieved data to assess trends. Classification levels provided for sieved and unsieved sediments are based on physical size and chemical characterization only, and should not be inferred to reflect chemical toxicity (concentrations reflective of toxicological levels are discussed in greater detail in Section 2.2 of this SLERA). IEPA's *Evaluation of Illinois Sieved Stream Sediment Data; 1982-1995* (1997) is used for this evaluation (Table C-5a). The IEPA document describes a classification of sieved sediment data (*e.g.*, non-elevated, elevated, and highly elevated) based on a large dataset of sediments collected throughout Illinois. Similar classification levels for unsieved sediments in Illinois, developed by Kelly and Hite (1984), is also included in Table C-5a. The Kelly and Hite unsieved values are most appropriate for comparison, because the sediment samples collected for the Eagle Zinc Site were unsieved. The comparisons of on Site and off Site data to both sieved and unsieved classification levels is provided on Tables C-5b (sieved) and C-5c (unsieved).

2.1.3 Description of Constituent Fate and Transport Pathways

After the environmental setting and the constituents are described, the next step in the screening-level problem formulation is consideration of the fate and transport pathways that might allow a constituent to interact with an organism. Knowledge about the potential fate and transport pathways of the constituents detected is vital to understanding which chemicals and receptors are associated with complete exposure pathways. This is because the pathway and route of exposure may have a strong influence on the ecological effect of a constituent. This information is ultimately used to develop the conceptual Site model (CSM).

Potential migration pathways at the Site were evaluated in the Phase 2 Technical Memorandum (ENVIRON 2003b). With the exception of the limited area where chlorinated volatile organic compounds were detected in sediments and surface water, the constituents in Site media are all metals. The concentration and distribution of these metals in environmental media on and in the vicinity of the Site could be (and/or could historically have been) affected by one or more of the following general mechanisms, as illustrated in Figure 2-6a and Figure 2-6b:

- Suspension and transport of constituents in air
- Suspension and transport of constituents in surface water runoff
- Leaching of constituents from residue material to underlying soil and groundwater

- Migration of constituents in groundwater
- Groundwater-to-surface water transport of constituents

A detailed evaluation of available historical data for the Site, including the off Site soil data collected by IEPA in 1993 as part of the CERCLA Expanded Site Inspection (ESI), was performed to evaluate these potential transport pathways. As discussed in the Phase 1 Technical Memorandum (ENVIRON 2003a), available data and information concerning the residue material does not suggest that air deposition has impacted nearby off Site areas.

The predominant topographic slope of the Site is southerly, and the southwestern stormwater pond receives a large proportion of the Site's stormwater runoff (i.e., the Western Drainage, Figure 2-6a). Stormwater intermittently discharges westward from this pond to an unnamed drainage swale, which in turn discharges to an unnamed tributary of Middle Fork Shoal Creek. The eastern stormwater retention system discharges to a drainage swale that channels the stormwater from the Site to the east and ultimately into Lake Hillsboro, approximately ½-mile east of the Site (i.e., the Eastern Drainage, Figure 2-6b). As a result, surface water impact could occur in both the Western Drainage and the Eastern Drainages due to constituents being carried off Site in stormwater runoff. However, it should be noted that stormwater discharge from both the Western and Eastern Drainages was managed via a NPDES permitted outfalls prior to permit cancellation in May 2003.

Based on groundwater contour maps previously constructed for the Site (ENVIRON 2003b), shallow groundwater in the western and southwestern portions of the Site flows southward/southwestward (towards and parallel to the Western Drainage Area), and shallow groundwater in the eastern portion of the Site flows eastward/southeastward (towards and parallel to the Eastern Drainage Area). Therefore, discharge of groundwater into surface water bodies proximate to the Site could also be a source of constituents to off Site surface water bodies. On Site areas within the Eastern Drainage Area include large non-operational areas (e.g., the Northern Area and areas east of the Manufacturing Area) and lack significant source areas, such as residue materials. The fact that no dissolved metals were detected above applicable groundwater screening concentrations in these wells (ENVIRON 2003b) reflects the known lack of source areas that are impacting groundwater in the areas east of the Site. Thus, the available data indicate that groundwater flow to the Eastern Drainageway and Lake Hillsboro is not a significant transport pathway. Based on the limited off Site extent of groundwater impacted by dissolved metals concentrations to the southwest of the Site, it is similarly concluded that groundwater discharge is not a significant pathway for the off Site transport of constituents to the Western Drainage.

2.1.4 Description of Constituent Mechanisms of Ecotoxicity

The mechanisms of ecotoxicity for constituents vary depending on a wide range of factors, such as constituent concentration, the wildlife receptor species exposed, the exposure route (e.g., ingestion or direct contact), and physical factors (e.g., pH, temperature, oxygen levels). Some of the effects that could be observed in wildlife are mortality and reduced reproductive ability, decreased fertility, decreased offspring survival, alteration of immune and behavioral function, decreased hatching success of eggs/larvae, and retarded growth (Sample, et al. 1996; USEPA 2002). The remainder of this section discusses mechanisms of ecotoxicity for the classes of compounds detected at the Site. These descriptions of constituent mechanisms of toxicity are presented without consideration of constituent concentrations, as the descriptions seek to convey an understanding of possible effects rather than describe the concentrations at which these effects might occur. More detail will be provided, as necessary for specific comments in the BERA (Step 3a).

2.1.4.1 Inorganic Constituents/Metals

The potential adverse impacts on aquatic wildlife from trace metals (such as arsenic, barium, beryllium, chromium, copper, lead, and zinc) are well understood (Newman, 1998). Chromium, copper, and zinc are essential for healthy enzyme function, and some organisms cannot survive without these metals. However, these naturally occurring constituents may cause adverse effects when exposure occurs at concentrations that significantly exceed background concentrations. The toxicity and effects of trace metals may be greatly influenced by pH, hardness, and organic carbon content of the water in which they occur (Leland and Kuwabara 1985).

Imbalances in the essential trace metals may cause a decrease in photosynthetic ability, poor spawning/hatching success, teratogenesis, susceptibility to predation and disease, reduced growth, mortality, histopathological changes, organ dysfunction of the liver or kidneys, neurological defects, changes in respiration and osmoregulation, and anemia. Some metals may bioaccumulate, but this mechanism is thought to be of minor ecological concern. Because these constituents are naturally occurring, many organisms have a capacity (albeit limited) to biotransform and/or eliminate naturally occurring inorganics (Newman 1998; Leland and Kuwabara 1985).

2.1.4.2 Volatile Organic Compounds

Volatile organic compounds (VOCS) tend to attenuate rapidly in surface soil due to their inherent volatility. Although the effects of VOCs on wildlife are not well understood, there have been extensive studies of the effects of VOCs under laboratory conditions. In laboratory test organisms, inhaled VOCs are typically metabolized in the liver, which may cause liver damage or the release of more toxic secondary metabolites. The VOC or its metabolites may also cause neurological damage, and many are mutagenic or carcinogenic. Additionally, some VOCs are fetotoxic and/or teratogenic (USEPA, 2003a).

2.1.5 Description of Potentially Exposed Receptors

The identification of the categories of receptors most likely affected helps focus the SLERA. Section 2.1.1 and Appendix A provide descriptions of the terrestrial and aquatic habitat and wildlife on Site and off Site. This information was used to develop the CSM illustrated in Figure 2-7. As illustrated on the CSM, terrestrial and aquatic wildlife and plants could be exposed to constituents from the Site.

2.1.6 Identification of Potentially Complete Exposure Pathways

A complete exposure pathway is one in which constituents can be traced or expected to travel from the source to a receptor that can be affected by the constituents (USEPA 1997). Therefore, a chemical, its release and migration from the source, a receptor, and the mechanisms of toxicity of that chemical must be demonstrated before a complete exposure pathway can be identified. The components of an exposure pathway (the constituents, their migration, their effects, and the receptors) have already been discussed. The table below, and Figure 2-7 illustrate the potentially complete exposure pathways that will be evaluated in the SLERA.

Identification of Potentially Complete Exposure Pathways

Organism	Possible Exposure Routes
Aquatic biota	Ingestion, respiration, surface contact, food web
Avian/mammalian piscivores	Ingestion, surface contact, food web
Terrestrial avian/mammalian wildlife	Ingestion, surface contact, food web

2.1.7 Identification of Generic Assessment and Measurement Endpoints

Assessment endpoints are the explicit expression of the ecological values to be protected (USEPA 1997). The selection of assessment endpoints depends on knowledge of the receiving environment, knowledge about the constituents released (including ecotoxicological properties and concentrations that cause adverse impacts), and understanding of the values that will drive risk management decision-making (Suter, et al. 1995). "For the SLERA, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments. Many of the ecotoxicity screening values are based on generic assessment endpoints (e.g., protection of aquatic communities from changes in structure or function) and are assumed to be widely applicable to Sites around the United States" (USEPA 1997).

Since direct measurement of assessment endpoints is often difficult (or impossible), surrogate endpoints (called measurement endpoints) are used to provide the information necessary to evaluate whether the values associated with the assessment endpoint are being protected. A measurement endpoint is a measurable ecological characteristic and/or response to a stressor (USEPA 1998). Measurement endpoints are also referred to as measures of potential effect (USEPA 1998). Measurement endpoints, such as mortality, reproductive effects, and reduced growth are considered for the SLERA but are not directly measured. These measurement endpoints are indirectly evaluated in the SLERA through the use of hazard quotients (HQs). An HQ is the ratio of a constituent concentration to an associated ecotoxicity screening value. The measurement endpoints/HQs for the Site are discussed further in Section 2.2.

Surrogate wildlife receptors must also be identified in order to perform necessary SLERA exposure estimates and risk calculations. These species are generally selected based on consideration of presence at the Site as well as known or suspected sensitivity and exposure to the constituents of potential concern (USEPA 1997).

The SLERA assessment endpoints, measurement endpoints, and surrogate receptors (where appropriate) for the Site are identified as follows:

SLERA Identification of Generic Assessment and Measurement Endpoints

Ecological Receptor	Assessment Endpoint	Surrogate Receptors	Measurement Endpoint
Aquatic biota (On Site and Off Site)	Maintenance of diverse and abundant aquatic communities	Water column and benthic communities	Comparison of maximum on Site and off Site detected concentrations to surface water and sediment ecotoxicity screening values
Avian and mammalian piscivorous wildlife (On Site and Off Site)	Survival and reproductive ability of populations	Mink, heron	Comparison of maximum on Site and off Site surface water chemical concentrations to piscivorous wildlife ingestion-based NOAELs
Terrestrial mammals and birds (On Site)	Survival and reproductive ability of populations	Deer mouse, American robin, red-tailed hawk	Food web modeling using maximum on Site soil concentrations with comparison to ingestion-based NOAELs

NOAELs No Observed Adverse Effects Levels.

2.2 Screening-Level Ecological Effects Evaluation

The screening-level ecological effects evaluation involves the identification of appropriate ecotoxicity screening values (ESVs) for each medium. ESVs are chemical concentrations in environmental media below which there is negligible risk to receptors exposed to those media (USEPA 2000a). ESVs are available from a broad range of federal and state sources, one or more of which may be applicable for any given Site. Further, ESVs for all media and all receptors may not be available from each source; thus, consideration of a range of sources provides greater opportunity for identification of ESVs. The ESVs used in this SLERA are described below:

2.2.1 SLERA Surface Water and Sediment Ecotoxicity Screening Values (Direct Toxicity)

The surface water ESVs are summarized on Table 2-1a. They are based on the following hierarchy for the designation of a single ESV for use in the SLERA. Criteria summarized on this table are chronic values (when available) as these values represent long-term exposures and are generally more conservative than acute values. It has been stated that the National Recommended Water Quality Criteria (NRWQC) (USEPA 2002a; 2002b), and similar criteria such as the Illinois Water Pollution Control Board (IWPC) Water Quality Criteria (2002), are intended to protect "95 percent of the species 95 percent of the time." However, these criteria are not available for every constituent. As such, alternative sources of criteria, such as the Secondary Chronic Values (Suter and Tsao 1996) are used (it should be noted that "primary" criteria are considered the NRWQC). Secondary chronic values are considered less rigorous than the NRWQC and IWQC because fewer toxicity studies representing fewer species are used in the derivation (Suter and Tsao 1996). USEPA Region 4 (2000b) and USEPA Region 5 (2003b) use a combination of criteria from a variety of sources, including the NRWQC. For this SLERA, ESVs were selected using the hierarchy presented in the bulleted list below:

- IWPC Water Quality Criteria (2002a; 2002b)
- USEPA NRWQC (2002)
- Suter and Tsao Secondary Chronic Values (1996)
- USEPA Region IV (2000c)
- USEPA Region V (2003)

The sediment ESVs are summarized on Table 2-2. The criteria summarized on this table are guidelines derived to protect organisms that live and feed in direct contact with sediment (i.e., sediment benthos). Conservative values, such as threshold effects levels (TELs) were selected in place of values such as probable effects levels (PELs) or severe effects levels (SELs). A range of ESVs available from a variety of sources is shown on Table 2-2. The ESVs used in this SLERA were selected from the hierarchy presented in the bulleted list below:

- USEPA Region IV (2000b)
- USEPA Region V (2003b)
- National Oceanic and Atmospheric Administration (NOAA 1999)
- United States Geologic Survey (Ingersoll et al. 2000)
- Ontario Ministry of the Environment (OME 1993)

2.2.2 SLERA Water and Dietary Prey Ecotoxicity Screening Values for Piscivorous Wildlife

Piscivorous wildlife water/dietary prey ESVs are summarized on Table 2-3, with a more complete documentation of the screening values presented in Appendix D (Table D-1a). The ESVs used to evaluate exposures to piscivorous wildlife in this SLERA are the most conservative NOAEL-based screening values for either the mink or great blue heron. The piscivorous wildlife NOAEL-based ESVs were developed by Sample et al. (1996) using an equation that allows the comparison of detected water concentrations to the ESVs that are reflective of COPC intake via both water and dietary prey. These NOAELs used in the ESV derivation are based on chronic exposures to piscivorous wildlife, and reflect values where diminished survival or diminished reproductive capacity would not be expected (i.e., no observable adverse effects).

2.2.3 SLERA Ecotoxicity Screening Values for Soil Food Web Exposures to Terrestrial Wildlife

The terrestrial mammalian and avian NOAELs are also summarized on Table 2-3, with a more complete documentation presented in Appendix D (Table D-1b and D-1c, for mammalian and avian receptors, respectively). The SLERA avian and mammalian NOAELs are based on the compilation of Sample et al. (1996). Similar to that described for piscivorous wildlife, these NOAELs are based on chronic exposures to wildlife, and reflect values where diminished survival or diminished reproductive capacity would not be expected.

These NOAELs are referred to as ESVs in this report because they are presented in a SLERA screening context. However, unlike the piscivorous wildlife NOAELs, which involve direct comparison of detected water concentrations to the piscivorous wildlife NOAELs, the terrestrial wildlife NOAELs are based on species-specific food web modeling calculations. These modeling calculations are discussed further in Section 3 of this SLERA. Further, mammalian NOAELs from Sample, et al., (1996) required mathematical extrapolation to provide estimates of deer mouse NOAELs (derived from data on laboratory test species). This mathematical formula is described in Appendix D, Table D-1b and Table D-2a. Per Sample et al., avian NOAELs do not require a similar mathematical extrapolation. The avian NOAELs are the same regardless of avian species (i.e., the same NOAEL values are used for both the American robin and the red-tailed hawk, even if based on a mallard duck study, as identified in Appendix D-1c).

3.0 STEP 2: SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK CALCULATION

The screening-level exposure assessment is comprised of the identification of exposure estimates, risk calculations, and the evaluation of uncertainties (USEPA, 1997; 2001a). These form lines of evidence to support the scientific management decision point (SMDP) at the conclusion of the SLERA.

3.1 Identification of Screening-Level Exposure Estimates

This section describes the exposure estimate assumptions used in the SLERA for aquatic wildlife exposed directly to surface water and sediment (described in Section 3.1.1), piscivorous wildlife exposures via ingestion of surface water and dietary prey (described in Section 3.1.2), and terrestrial wildlife exposures via food web exposures (described in Section 3.1.3).

3.1.1 Screening-Level Exposure Estimates for Aquatic Wildlife: Surface Water and Sediment (Direct Toxicity)

The maximum concentrations detected in the on Site and off Site surface water and sediment samples were used for this SLERA as part of the evaluation of potential direct toxicity. These concentrations are summarized on the following tables, for the following media groupings:

- Table 3-1a: On Site Surface Water
- Table 3-1b: Off Site Surface Water
- Table 3-2a: On Site Sediment
- Table 3-2b: Off Site Sediment

3.1.2 Screening-Level Water and Dietary Prey Exposure Estimates to Piscivorous Wildlife

The maximum concentrations detected in the on Site and off Site surface water samples were used for this SLERA as part of the evaluation of potential water and dietary toxicity for piscivorous wildlife. These concentrations are summarized on the following tables, for the following media groupings:

- Table 3-3a: On Site Surface Water
- Table 3-3b: On Site Surface Water

3.1.3 Screening-Level Estimates for Food Web Exposures to Terrestrial Wildlife

Food web exposure modeling involves many more inputs than the direct contact and piscivorous wildlife exposure estimates. The estimate of food web exposures to terrestrial wildlife involves a variety of factors, such as species-specific food web modeling intake formulae, medium-specific concentrations (i.e., soil and water concentrations) species-specific exposure parameters, and bioaccumulation/bioconcentration factors for the estimation of chemical concentrations in dietary prey. This section identifies the exposure parameter values used for the terrestrial food web exposure modeling. Per discussions with USEPA, only those constituents identified as bioaccumulative compounds in USEPA's *Bioaccumulation Testing and Interpretation of Sediment Quality Assessment* (USEPA 2000c) are included in this evaluation. The bioaccumulative constituents detected in the soil and water at the Site are:

- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Zinc

3.1.3.1 Species-Specific Food Web Modeling Formulae

Food web modeling involves consideration of chemical parameters such as soil and water concentrations, as well as consideration of species-specific food and water intake rates, normalized to a species body weight. An overview of the species-specific food web modeling approaches and equations is provided in Appendix D, for the following receptors:

- Table D-2a: Deer Mouse
- Table D-2b: American Robin
- Table D-2c: Red-Tailed Hawk

3.1.3.2 Medium-Specific Concentrations

The maximum concentrations detected in the on Site soil and surface water samples were used for this SLERA as part of the evaluation of potential water and food web toxicity for terrestrial mammalian and avian wildlife. These concentrations are summarized on the following tables, for the following receptors:

- Table 3-4a: Deer Mouse
- Table 3-4b: American Robin
- Table 3-4c: Red-Tailed Hawk

3.1.3.3 Species-Specific Exposure Parameters

Species-specific exposure parameters that are used in the SLERA food web exposure modeling are conservative values designed to provide maximum estimates of exposure (USEPA, 1997). For example, a dietary makeup that maximizes potential dietary exposure is selected for the SLERA, while a more realistic dietary makeup would be used for subsequent evaluation (if needed). For the SLERA, a conservative low body weight is estimated for use in the ingestion intake calculations, while an elevated body weight is used in the allometric equations estimating food and water ingestion rates (USEPA 1993; Sample and Suter 1994). In addition, Site foraging frequency is assumed to be a value of 1, assuming that the species spends 100 percent of its time in the portion of the Site with maximum detected concentrations, even species with a large home range. Similarly, species that migrate are assumed to spend 100 percent of their time at the Site, even when it is known that they migrate for a portion of the year. These conservative default assumptions are consistent with a SLERA approach and are summarized in Appendix D, for the following receptors:

- Table D-3a: Deer Mouse
- Table D-3b: American Robin
- Table D-3c: Red-Tailed Hawk

3.1.3.4 Bioaccumulation Factors and Bioconcentration Factors

Bioaccumulation factors and bioconcentration factors are used to estimate tissue concentrations in food web modeling (Sample et al. 1998a&b; Bechtel 1998). Chemical concentrations in soil are multiplied by bioconcentration factors to estimate tissue concentrations for invertebrates and vegetation, while bioaccumulation factors are used to estimate uptake into mammals. The mathematical formulae presented in Appendix D-2a, D-2b, and D-2c illustrate this approach (though the terms used in these formulae are more generally denoted as "uptake factors"). While both 90th percentile and median bioaccumulation and bioconcentration factors are summarized in Appendix D-4, the more conservative 90th percentile values are used for the SLERA. These values were compiled from the following sources:

- Sample et al. (1998a)
- Sample et al. (1998b)
- Bechtel (1998)

3.2 Screening-Level Risk Calculations

Risks are calculated in this SLERA by dividing conservative chemical-specific exposure estimates (described in Section 3.1) by conservative chemical-specific ESVs (described in Section 2.2). These unitless chemical-specific ratios are referred to as hazard quotients (HQs). HQs are considered a surrogate for the assessment endpoint, which is the protection of wildlife populations and communities at the Site (as described in Section 2.1.5). An HQ equal to or less than a value of 1 (to one significant figure) indicates that adverse impacts to wildlife are considered unlikely (USEPA 1997; 2000a). An HQ greater than 1 is an indication that further evaluation may be necessary to evaluate the potential for adverse impacts to wildlife. Therefore, the constituents with HQs greater than 1 are carried forward as constituents of potential concern (COPCs) into a BERA. The remainder of this section describes SLERA risk calculations for (1) direct toxicity to aquatic organisms (surface water and sediment), (2) dietary and water intake to piscivorous wildlife, and (3) food web exposures to terrestrial wildlife.

3.2.1 SLERA Risk Calculations for Direct Toxicity to Aquatic Wildlife: Surface Water and Sediment

The risk calculations for aquatic wildlife are presented for each medium as follows: Table 3-1a (On Site Surface Water), Table 3-1b (Off Site Surface Water), Table 3-2a (On Site Sediment), and Table 3-2b (Off Site Sediment). Constituents with HQs greater than a value of 1 are summarized below.

Direct Toxicity HQs Greater Than 1

Constituent	Surface Water		Sediment	
	On Site HQ (Table 3-1a)	Off Site HQ (Table 3-1b)	On Site HQ (Table 3-2a)	Off Site HQ (Table 3-2b)
Aluminum		20		
Arsenic				3
Barium	10	20		
Cadmium	90	10	600	100
Copper			3	20
Iron		3		2
Lead			8	90
Manganese	3	5		2
Mercury			10	10
Nickel	2		2	2
Zinc	400	400	100	200
Acetone			5	

Blank cells indicate that the HQ was less than or equal to 1, the constituent was not detected, or there was no available ecological screening value.

Constituents with HQs greater than 1 will be carried forward into Step 3a of the BERA for further evaluation of potential impacts to aquatic wildlife via direct contact. Step 3a of the BERA will focus on these constituents in the data groupings where elevated HQs were identified (e.g., zinc will be evaluated in on Site and off Site surface water and sediment, while arsenic will only be evaluated in off Site sediment). In addition, constituents for which ecotoxicity screening values were not available for a medium will also be carried forward as COPCs in that medium in Step 3a of the BERA. These constituents are summarized below by medium:

- Surface water – Calcium, magnesium, potassium, sodium, and sulfate
- Sediment – Aluminum, barium, beryllium, calcium, magnesium, potassium, selenium, sodium, vanadium, 2-butanone, and cis-1,2-dichloroethene

3.2.2 SLERA Risk Calculations for Piscivorous Wildlife – Water and Dietary Prey

The risk calculations for piscivorous wildlife for on Site and off Site piscivorous wildlife surface water/dietary prey exposures are presented in Table 3-3a and 3-3b, respectively. Constituents with HQs greater than a value of 1 are summarized below.

Piscivorous Wildlife HQs Greater Than 1

Constituent	On Site HQ (Table 3-3a)	Off Site HQ (Table 3-3b)
Aluminum		60
Cadmium	500	80
Mercury		20
Selenium		5
Zinc	300	300

Blank cells indicate that the HQ was less than or equal to 1 or the constituent was not detected.

Constituents with HQs greater than 1 will be carried forward into Step 3a of the BERA for further evaluation of potential impacts to piscivorous wildlife via water and dietary intake. In addition, the following constituents for which piscivorous wildlife ecotoxicity screening values were not available will also be carried forward as COPCs in Step 3a of the BERA:

- Barium, calcium, cobalt, iron, magnesium, manganese, potassium, silver, sodium, sulfate, vanadium, cis-1,2-dichloroethene, trichloroethylene

3.2.3 SLERA Risk Calculations for Terrestrial Wildlife: Soil Food Web Exposures

Risk calculations for piscivorous wildlife are presented in Table 3-4a, 3-4b, and 3-4c, for deer mouse, American robin, and red-tailed hawk food web risk calculations, respectively. Constituents with HQs greater than a value of 1 are summarized below.

Terrestrial Wildlife HQs Greater Than 1

Constituent	Deer Mouse (Table 3-4a)	American Robin (Table 3-4b)	Red-Tailed Hawk (Table 3-4c)
Arsenic	30		
Cadmium	500	600	30
Chromium		30	
Lead	3	10	
Mercury		3	
Nickel	2		
Selenium	4		
Zinc	100	2,000	200

Note: Blank cells indicate that the HQ was less than or equal to 1

Constituents with HQs greater than 1 will be carried forward into Step 3a of the BERA on a receptor-specific basis. As can be seen on Tables 3-4a, 3-4b, and 3-4c, there are no constituents lacking NOAEL toxicity values.

3.3 Evaluation of Uncertainties

A SLERA is designed to provide conservative estimates of the potential risks that may exist for wildlife and, therefore, incorporates uncertainty in a precautionary manner. Uncertainty in an ERA is "the imperfect knowledge concerning the present or future state of the system under consideration; a component of risk resulting from imperfect knowledge of the degree of hazard or of its spatial and temporal distribution" (USEPA, 1997). Uncertainties that may lead to either an overestimation or an underestimation of risk are associated with each stage of risk assessment. A summary of uncertainties that are associated with an ERA is provided in Table 3-5a.

One of the uncertainties identified on Table 3-5a is that there are occasions when analytical detection limits exceed ESVs. This can be due to instrument and method limitations and/or due to interference from unrelated chemicals (e.g., dilutions required to bring some other chemical within a calibration range). A comparison of the minimum and maximum detection limits to ESVs for the Eagle Zinc Site is provided in Tables 3-5b and 3-5c for constituents that were not detected in surface water and sediment, respectively. Though a few of the constituents had a maximum detection limit that exceeded an ESV, only one of those maximum detection limits exceeded background (that was for silver, a non-Site related constituent that had a maximum detection limit HQ of 3 for direct contact versus a background HQ of 1). No such exceedances were observed in the sediment dataset.

3.4 Scientific Management Decision Point

SMDPs represent critical steps in the ecological risk assessment process where risk management decision-making occurs. The first SMDP in the ERA process may occur either at the end of Step 2 or Step 3a (USEPA, 2000a). The purpose of the flexibility of the first SMDP is so that additional evaluation of risks can occur and reporting can be streamlined into a single report. Generally, the following types of decisions are considered at this SMDP:

1. Whether the available information is adequate to conclude that ecological risks are negligible and, therefore, there is no need for further action on the basis of ecological risk.

2. Whether the available information is not adequate to make a decision at this point, and the ecological risk assessment process will continue.

3. Whether the available information indicates a potential for adverse ecological effects, and a more thorough assessment or remediation is warranted.

Initial activities associated with a BERA are warranted (i.e., Step 3a) because the results of the screening-level risk calculation result in HQs greater than 1, and because this information is not adequate for decision-making. Therefore, as described in the following sections, the risk assessment will proceed to Step 3a for the receptors, media, and constituents described below, and the SMDP will occur at the conclusion of Step 3a:

3.4.1 Direct Toxicity for Aquatic Wildlife Exposed to Surface Water and Sediment

The following constituents will be further evaluated based on HQs greater than a value of 1 in the SLERA:

- <u>On Site surface water</u> – Barium, cadmium, manganese, nickel, and zinc
- <u>Off Site surface water</u> – Aluminum, barium, cadmium, iron, manganese, and zinc
- <u>On Site sediment</u> – Cadmium, copper, lead, mercury, nickel, zinc, and acetone
- <u>Off Site sediment</u> – Arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel, and zinc

In addition, due to the lack of ESVs for a variety of constituents, these will be carried forward in the BERA for each media and data grouping in which they are detected:

- <u>On Site and off Site surface water</u> – Calcium, magnesium, potassium, sodium, and sulfate
- <u>On Site and off Site sediment</u> – Aluminum, barium, beryllium, calcium, magnesium, potassium, selenium, sodium, vanadium, 2-butanone, and cis-1,2-dichloroethene

3.4.2 Piscivorous Wildlife Exposed via Water and Dietary Prey

The following constituents will be further evaluated for potential risks to piscivorous wildlife based on HQs greater than a value of 1 in the SLERA:

- <u>On Site surface water</u> – Cadmium and zinc
- <u>Off Site surface water</u> – Aluminum, cadmium, mercury, selenium, and zinc

In addition, the following constituents also be carried forward as COPCs in Step 3a of the BERA due to the lack of piscivorous wildlife ESVs in the SLERA:

- Barium, calcium, cobalt, iron, magnesium, manganese, potassium, silver, sodium, sulfate, vanadium, cis-1,2-dichloroethene, trichloroethylene

3.4.3 Terrestrial Wildlife Exposed via the Food Web

The following constituents will be further evaluated for each wildlife receptor based on HQs greater than a value of 1 in the SLERA (and there are no constituents that will be carried forward into Step 3a of the BERA based on the lack of ESVs):

- Deer Mouse – Arsenic, cadmium, lead, nickel, selenium, and zinc
- American Robin – Cadmium, chromium, lead, mercury, and zinc
- Red-Tailed Hawk – Cadmium and zinc

4.0 STEP 3A: BASELINE ERA PROBLEM FORMULATION (REFINEMENT OF STEP 2 SCREENING-LEVEL ERA EXPOSURE ESTIMATES AND RISK CALCULATIONS)

The BERA problem formulation is designed to more realistically identify the nature and extent of ecological risks in order to support informed environmental management decision-making (USEPA, 1997; 2000a). This is in contrast to the SLERA, which is designed to conservatively rule out further evaluation of chemicals and media that clearly do not pose significant ecological risk. The BERA problem formulation presented in this section is consistent with the RI/FS Work Plan (ENVIRON 2002a) and the following guidance:

- Ecological Risk Assessment Guidance for Superfund (USEPA, 1997)
- Guidelines for Ecological Risk Assessment (USEPA, 1998)
- Amended Guidance on Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders (USEPA, 2000a)
- ECO-Update: Role of Screening-level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments (USEPA, 2001a)

The BERA problem formulation (Step 3) is the initial step in the BERA process, as illustrated on Figures 1-1 and 1-2. According to the USEPA (2000a):

> *"The Problem Formulation [i.e., Step 3] is commonly thought of in two parts: Step 3a and Step 3b. Step 3a serves to introduce information to refine the risk estimates from steps one and two. For the majority of Sites, ecological risk assessment activities will cease after completion of Step 3a. At many Sites, a single deliverable document consisting of the reporting of results from Steps 1, 2 and 3a may be submitted. At those Sites with greater ecological concerns, the additional problem formulation is called Step 3b. It is very important at this stage to perform a 'reality check.' Sites that do not warrant further study should not be carried forward."*

Step 3a of the ERA process (i.e., Problem Formulation) is an opportunity for iterative refinement of potential risks using methods similar to those used in Steps 1 and 2 (USEPA 2000a; 2001b), as illustrated on Figure 1-2. Specifically, COPCs identified in the SLERA may be eliminated from further consideration based on the refinement of certain assumptions, such as reasonable chemical exposure estimates, background/reference location comparisons, and consideration of more realistic bioaccumulation potential. Step 3a is followed by a SMDP that involves the reporting of results to stakeholders for the Eagle Zinc Site. The components of Step 3a are presented in the remainder of this section.

Step 3a is a refinement of the Step 2 exposure estimates and risk characterization, focused only on the constituents and media that progress beyond the SLERA (i.e., those constituents and media specified in Section 3.4 of this report). Step 3a for the Eagle Zinc Site involves the following:

- Section 4.1: Refined Evaluation of Direct Toxicity Exposures and Risks for Aquatic Wildlife
  - Section 4.1.1: Refinement Of Direct Contact Surface Water And Sediment COPCs
  - Section 4.1.2: Refinement of Direct Contact Risk Calculations for Aquatic Wildlife
  - Section 4.1.3: Overall Conclusions For Aquatic Wildlife
- Section 4.2: Refined Evaluation of Water/Dietary Exposures and Risks for Piscivorous Wildlife
  - Section 4.2.1: Refinement of Piscivorous Water/Dietary COPCs
  - Section 4.2.2: Refinement of Piscivorous Risk Calculations
  - Section 4.2.3: Overall Conclusions for Piscivorous Wildlife
- Section 4.3: Refined Evaluation of Food Web Exposures and Risks for Terrestrial Wildlife
  - Section 4.3.1: Refinement of Terrestrial Food Web COPCs
  - Section 4.3.2: Refinement of Terrestrial Wildlife Risk Calculations
  - Section 4.3.3: Overall Conclusions for Terrestrial Wildlife
- Section 4.4: Refined Uncertainties
- Section 4.5: Scientific Management Decision Point

4.1 Refined Evaluation of Direct Toxicity Exposures and Risks for Aquatic Wildlife

This section presents the refinement of direct contact surface water and sediment COPCs (Section 4.1.1), the refinement of direct contact risk calculations for aquatic wildlife (Section 4.1.2), and overall conclusions regarding risks to aquatic wildlife (4.1.3).

4.1.1 Refinement Of Direct Contact Surface Water And Sediment COPCs

The refinement of the COPCs identified in the SLERA is necessary to help focus further risk assessment activities on the constituents that potentially pose the greatest risk to ecological receptors. USEPA guidance for this approach (USEPA, 1997; 2000a; 2001a) indicates that the refinement of COPCs streamlines the overall ERA process by using realistic criteria to focus the risk assessment. It is intended as an "incremental iteration of exposure, effects, and risk characterization" (USEPA, 2001a). The outcome of this screening is that constituents are either excluded as COPCs or retained for further evaluation in the BERA process.

The refinement of surface water and sediment COPCs is based on four steps: (1) data grouping, (2) identification of SLERA COPCs for each data grouping, (3) refined screening against background and ESVs, and (4) identification of Step 3a COPCs to be carried forward into the refined risk calculations.

(1) Data Groupings - Surface water and sediment data sets remain in on Site and off Site data groupings, as presented in the SLERA. These data sets are further subdivided into Eastern Drainage and Western Drainage data sets, as identified in Appendix C (Table C-1). Background data for each medium and data set are also identified. Note that surface water samples were not available for an evaluation of the on Site Eastern Drainage data set because the on Site Eastern Drainage channels were dry during the sampling event. Appendix Tables C-6, C-7, and C-8 provide the following information (based on the data groupings identified in Table C-1):

- Table C-6a: Occurrence of Constituents in Surface Water (Eastern Drainage: Off Site)
- Table C-6b: Occurrence of Constituents in Surface Water (Western Drainage: On Site)
- Table C-6c: Occurrence of Constituents in Surface Water (Western Drainage: Off Site)

- Table C-7a: Occurrence of Constituents in Sediment (Eastern Drainage: On Site)
- Table C-7b: Occurrence of Constituents in Sediment (Eastern Drainage: Off Site)
- Table C-7c: Occurrence of Constituents in Sediment (Western Drainage: On Site)
- Table C-7d: Occurrence of Constituents in Sediment (Western Drainage: Off Site)

- Table C-8a: Occurrence of Constituents in Background Surface Water (Eastern and Western Drainages)
- Table C-8b: Occurrence of Constituents in Background Sediment (Eastern and Western Drainages)

(2) Identification of SLERA COPCs for each Data Grouping – Constituents identified as COPCs in the SLERA (Sections 3.2.1 and 3.4) are carried into the refinement process in the subdivided data sets (Eastern-On Site; Eastern-Off Site, Western-On Site; Western-Off Site). For example, any constituent identified as an "off Site surface water COPC" in the SLERA is identified for both the "Eastern Drainage: Off Site" and the "Western Drainage: Off Site" refinement of COPCs evaluations.

(3) Refined Screening – For each data grouping, refined screening involves consideration of maximum detected concentrations, exposure point concentrations (EPCs), background concentrations, and SLERA ESVs. Note that the EPCs are 95 percent upper confidence limit (UCL) estimates of mean concentrations, unless UCLs exceeded the maximum concentration, in which case the maximum concentration is used as the EPC. Within each data grouping, the EPCs are compared to appropriate background data. It should be noted that calcium, magnesium, potassium, and sodium are not evaluated in this manner because they are essential nutrients (USEPA, 2001a) and were typically detected at or less than twice background concentrations. For those constituents that have EPCs greater than the background constituents, the EPCs are then compared to SLERA ESVs (i.e., the same ESVs used for risk calculations in the SLERA [Section 3.2.1]). Constituents are carried forward as Step 3a COPCs when both of the following conditions are met:

- EPCs exceed background (or no background value is available), and
- EPCs exceed SLERA ESVs (or no ESV is available).

(4) Identification of Step 3a COPCs - The identification of the Step 3a COPCs is provided for each data grouping using the refinement process described above, on Tables 4-1(a through c) and 4-2, (a through d) as follows:

- Table 4-1a: Refinement of Direct Contact Surface Water COPCs (Eastern Drainage: Off Site)
- Table 4-1b: Refinement of Direct Contact Surface Water COPCs (Western Drainage: On Site)
- Table 4-1c. Refinement of Direct Contact Surface Water COPCs (Western Drainage: Off Site)

- Table 4-2a: Refinement of Direct Contact Sediment COPCs (Eastern Drainage: On Site)
- Table 4-2b: Refinement of Direct Contact Sediment COPCs (Western Drainage: Off Site)
- Table 4-2c: Refinement of Direct Contact Sediment COPCs (Eastern Drainage: On Site)
- Table 4-2d: Refinement of Direct Contact Sediment COPCs (Western Drainage: Off Site)

The COPCs carried forward into Step 3a based on the refinement described in this section are:

Summary of Direct Contact COPCs for Each Medium

Data Grouping	COPCs
Surface Water	
Eastern: Off Site (Table 4-1a)	Cadmium, manganese, sulfate, zinc
Western: On Site (Table 4-1b)	Cadmium, nickel, sulfate, zinc
Western: Off Site (Table 4-1c)	Aluminum, cadmium, manganese, sulfate, zinc
Sediment	
Eastern: On Site (Table 4-2a)	Aluminum, barium, cadmium, zinc
Eastern: Off Site (Table 4-2b)	Aluminum, barium, beryllium, cadmium, copper, lead, manganese, mercury, nickel, vanadium, zinc
Western: On Site (Table 4-2c)	Cadmium, copper, lead, mercury, nickel, selenium, vanadium, zinc, 2-butanone, acetone, cis-1,2-dichloroethene
Western: Off Site (Table 4-2d)	Aluminum, arsenic, barium, cadmium, copper, lead, mercury, nickel, selenium, zinc

4.1.2 Refinement of Direct Contact Risk Calculations for Aquatic Wildlife

This section describes the process used to refine risk calculations (Section 4.1.2.1), identifies the HQs greater than 1, presents an interpretation of the significance of those HQs (Section 4.1.2.2), identifies the constituents lacking ESVs in this refinement process, provides an interpretation of whether these constituents may be problematic (Section 4.1.2.3), and provides an overall summary of estimated risks to aquatic wildlife (Section 4.1.2.4).

4.1.2.1 Refinement Process

In Step 3a of the BERA, the SLERA risk calculations are refined for direct contact COPCs by recalculating HQs using more realistic exposure estimates and/or more realistic toxicity values. In this refinement, location-specific concentrations are used rather than exclusively the maximum detected concentrations from the data groupings that were used in the SLERA. The refinement of the risk calculations also involves the use of expanded ESVs, as described below.

Surface Water: The chronic ESVs that were presented in the SLERA are used for the calculation of location-specific HQs (thus, the maximum HQ seen in the SLERA will be seen again, with its specific location identified). In addition, this expanded screening uses the acute Illinois Water Quality Standards (or National Recommended Water Quality Criteria if Illinois values are not available) for the calculation of location-specific HQs (the available surface water ESVs are summarized on Table 2-1a). Both chronic and acute values are appropriate for this refinement, as the chronic values illustrate the potential risks associated with long-term exposures for aquatic wildlife while the acute values illustrate the potential risks with short-term exposures for aquatic wildlife. For a limited number of constituents, acute and chronic ESVs are not available. For these constituents, Secondary Chronic ESVs from the SLERA remain the only ESVs available for use.

Sediment: Sediment ESVs that were presented in the SLERA are also used for the calculation of location-specific HQs (the available sediment ESVs are summarized on Table 2-2). In addition, ESVs such as the NOAA probable effects levels (PELs) and the USGS severe effects levels (SELs) are used. The use of these values allows for a greater understanding of whether impacts are "probable" or might be "severe."

The refined risk calculations for aquatic wildlife exposed to surface water and sediment are summarized, on Tables 4-3 and 4-4, as follows:

- Table 4-3a: Refined Surface Water Direct Contact Risk Calculations (Eastern Drainage: Off Site)
- Table 4-3b: Refined Surface Water Direct Contact Risk Calculations (Western Drainage: On Site)
- Table 4-3c: Refined Surface Water Direct Contact Risk Calculations (Western Drainage: Off Site)

- Table 4-4a: Refined Sediment Direct Contact Risk Calculations (Eastern Drainage: On Site)
- Table 4-4b: Refined Sediment Direct Contact Risk Calculations (Eastern Drainage: Off Site)
- Table 4-4c: Refined Sediment Direct Contact Risk Calculations (Western Drainage: On Site)
- Table 4-4d: Refined Sediment Direct Contact Risk Calculations (Western Drainage: Off Site)

4.1.2.2 Identification and Interpretation of Direct Contact HQs Greater than 1

The COPCs with HQs greater than 1 are summarized on the following table for each medium and each data grouping (constituents with HQs less than or equal to 1, the threshold value, are not discussed further in the BERA). Following the summary table, the ranges of HQs, spatial distribution of the elevated HQs, and potential significance to aquatic wildlife are discussed in greater detail (sampling locations are depicted on Figure 2-5a).

Summary of Refined Risk Calculations: HQs Greater than 1

	Eastern Drainage			Western Drainage			
	On Site	Off Site		On Site		Off Site	
Constituent	SD HQs Table 4-4a	SW HQs Table 4-3a	SD HQs Table 4-4b	SW HQs Table 4-3b	SD HQs Table 4-4c	SW HQs Table 4-3c	SD HQs Table 4-4d
Arsenic							0.8-3
Aluminum						2-20	
Cadmium	0.2-2	0.2-3	0.2-10	2-90	60-600	0.2-10	0.2-100
Copper			0.09-3		0.3-3		0.03-20
Iron							1-2
Lead			0.08-3		0.9-8		0.2-90
Manganese		3	0.7-2				
Mercury					0.7-10		0.01-10
Nickel				0.3-2	0.3-2		0.3-2
Zinc	1-7	40-200	0.6-90	50-400	10-100	10-400	2-200
Acetone					3-5		

Blank cells indicate that the constituent was not detected, the ESV was not available, or the HQ was less than or equal to 1

4.1.2.2.1 Eastern Drainage HQs Greater than 1

Surface Water (off Site) – The evaluation of surface water in the Eastern Drainage (off Site) involved two sampling locations, ED-13 and ED-16 (Figure 2-5a), as briefly described below:

- Off Site (Table 4-3a) – ED-13 (located adjacent to the Site boundary, with very little aquatic habitat) and ED-16 (located near Lake Hillsboro, with higher quality aquatic habitat).

At location ED-13, the only HQs greater than the threshold value of 1 are for cadmium (3, for chronic effects), manganese (3, for chronic effects), and zinc (40 to 200, for acute and chronic effects, respectively). At location SD-16, constituents were either not detected or not detected greater than background concentrations. It should be noted that sulfate was detected at concentrations greater than background at both locations; however, since no ESVs were available for sulfate, HQs were not calculated.

The flow characteristics and habitat quality of the off Site Eastern Drainage are important for understanding the significance of the HQs that exceed the threshold value. Specifically, at location ED-13, the drainage consists of a small intermittent channel. Therefore, though the HQs for cadmium, manganese, and zinc are elevated at ED-13, the HQs are considered unlikely to be representative of significant ecological effects (particularly compared to flow and overall habitat quality). Furthermore, because the HQs for COPCS at ED-16 did not exceed background concentrations and/or the threshold value, any ecological effects in the Eastern Drainage would be expected to be of limited spatial scale.

<u>Sediment (on Site and off Site)</u> – The evaluation of sediment in the Eastern Drainage involved one on Site sampling location and four off Site locations (Figure 2-5b), as briefly described below:

- On Site (Table 4-4a) – ED-12 (located in the woods north of the manufacturing area, with very little aquatic habitat).
- Off Site (Table 4-4b) – ED-13 (located adjacent to the Site boundary, with very little aquatic habitat), and progressing toward Lake Hillsboro with sampling locations ED-14, ED-15, and ED-16 (ED-16 is located nearest Lake Hillsboro, with higher quality aquatic habitat than the other sampling locations).

On Site at location ED-12, the only PEL-based HQ greater than 1 is for zinc (3). At location ED-13 (just off Site), the only PEL-based HQs greater than 1 are for cadmium (4) and zinc (3) with an SEL-based HQ of 10). The HQs diminish strongly as the drainage flows towards Lake Hillsboro, with PEL-based HQs greater than 1 for zinc only at ED-14 (20), and ED-15 (2). However, at ED-16 (the farthest downstream location in the Eastern Drainage), the HQs are very similar to those at ED-13 (a PEL-based HQ of 3 for cadmium, and PEL- and SEL-based HQs of 30 and 10 for zinc).

This information indicates that effects to sediment-dwelling organisms may occur near the area where the Eastern Drainage flows off Site (i.e., near ED-13), and that effects may also occur near the confluence with Lake Hillsboro (i.e., near ED-16). It is important to note, however, that any effects in the vicinity of ED-13 are not expected to be significant given the flow characteristics and habitat quality in the Eastern Drainage (i.e., intermittent until it approaches Lake Hillsboro). However, based on the SEL-based HQ of 10 for zinc at ED-16 and that habitat supportive of sediment dwelling organisms is present in the vicinity of ED-16, significant ecological impacts to sediment-dwelling organisms in proximity to ED-16 cannot be ruled out (although of limited spatial scale).

4.1.2.2.2 Western Drainage HQs Greater than 1

This section provides a discussion of HQs greater than 1 in the Western Drainage, and provides a narrative discussion of the potential ecological significance of those HQs in consideration of the flow characteristics and habitat quality both on and off Site within the drainage.

Surface Water (on Site and off Site) –The evaluation of surface water in the Western Drainage involved three on Site locations (including two stormwater pond locations) and four off Site locations (Figure 2-5a), as briefly described below:

- On Site (Table 4-3b) – WD-9 (located upgradient from the pond in an area with very little aquatic habitat), WD-PN (located at the northern end of the pond), and WD-PS (located at the southern end of the pond)
- Off Site (Table 4-3c) – WD-7 (located at the outfall of the pond, with very little aquatic habitat), WD-6 (located along the unnamed drainage upstream from the confluence with the unnamed tributary, in a developed park/residential area), WD-12 (located in the unnamed tributary to Middle Fork Shoal Creek), and WD-8 (located in the unnamed tributary south of the Site)

The HQs for the three on Site locations indicate that adverse impacts may occur due to cadmium and zinc in the surface water upstream of and in the pond. This is based on HQs ranging from 2 and 50 in the pond (for acute effects for cadmium and zinc, respectively), to 90 and 400 upstream of the pond (for chronic effects for cadmium and zinc, respectively). However, it is critical to note that background concentrations for cadmium and zinc are also associated with elevated HQs (e.g., a background HQ of 60 was calculated for zinc), and that the pond has been observed to support an abundance of fish, turtles, vegetation, and other aquatic life (see Section 2.1.1). In addition, though the HQs for location WD-9 (upstream of the pond) and WD-7 (just downstream of the pond and off Site) are associated with the most elevated HQs, these locations represent the least quality habitat due to extremely low water flow.

Moving further downstream, and off Site, the cadmium and zinc HQs attenuate quickly. By the time the Western Drainage reaches WD-6 in the unnamed drainage and joins the unnamed tributary to Middle Fork Shoal Creek, the HQs are approximately equivalent to the background HQs.

Though this information indicates that effects to aquatic wildlife may occur on-Site, the "predicted" effects are contradicted by on-Site observations. In addition, the information indicates that effects to aquatic wildlife may occur at off Site locations near the property boundary. However, these locations are not associated with habitat that is supportive of aquatic organisms. Therefore, although some of the HQs for surface water in the Western Drainage indicate the potential for adverse impacts to aquatic organisms, the impacts are not considered to be ecologically significant.

Sediment (on Site and off Site) – The evaluation of sediment in the Western Drainage on Site involved one on Site sampling location (and its duplicate) and four off Site locations (Figure 2-5b) as briefly described below:

- On Site (Table 4-4c) – WD-9 and its duplicate WD-9d (located upgradient from the pond in an area with very little aquatic habitat)
- Off Site (Table 4-4d) – WD-7 (located at the outfall of the pond, with very little aquatic habitat), WD-6 (located along the unnamed drainage just before its confluence with the unnamed tributary), WD-4, WD-3, WD-2, and WD-1 (located in the unnamed tributary flowing north toward Middle Fork Shoal Creek in succession from near the Site to furthest downstream), and WD-8 (located in the unnamed drainage south of the Site)

On Site, at location WD-9, PEL-based HQs greater than 1 were calculated for cadmium (200), lead (3), mercury (3), and zinc (40). In addition, SEL-based HQs greater than 1 were calculated for cadmium (60), and zinc (10). The HQs at WD-7, the nearest downgradient location and the first off Site location, are roughly equivalent to the HQs at WD-9. However, by the time the Western Drainage reaches WD-6, the HQs are greatly diminished. Once the drainage reaches the unnamed tributary, the HQs are approximately equal to the background HQs.

This information indicates that effects to sediment-dwelling organisms in the Western Drainage may occur on-Site and off Site near the property boundary, and that those effects are possible until the confluence of the drainage with the unnamed tributary to Middle Fork Shoal Creek. It is important to note, however, that the effects are not expected to be ecologically significant due to be generally poor habitat in the areas with elevated HQs. The information for locations with higher quality habitat, such as the unnamed tributary to Middle Fork Shoal Creek, indicate conditions that are favorable for sediment-dwelling organisms.

4.1.2.3 Constituents Lacking ESVs in Refined Direct Contact Risk Calculations

Aluminum, barium, beryllium, vanadium, 2-butanone, and cis-1,3-dicholorethene were detected in one or more sediment groupings but were not evaluated due to the lack of ESVs. Significant and or unacceptable risks are not expected for aquatic wildlife associated with these constituents because:

- Aluminum, barium, beryllium, selenium, and vanadium, are naturally occurring inorganic constituents that were detected in sediment at concentrations generally consistent with background concentrations, (with only a very limited number of exceptions; Tables B-2 and B-5).
- Selenium was detected in sediment on Site and off Site in the Western Drainage, but only in two locations, WD-9 and WD-7 (Table B-2). Habitat is limited in both locations.
- 2-Butanone and cis-1,2-dicholorethene were detected in sediment at one location in an area of the Site with limited aquatic habitat (WD-9). VOCs were not detected in surface water or sediment in any off Site samples.

4.1.3 Overall Conclusions For Aquatic Wildlife

Based on the information developed and presented in the section, it can be concluded with reasonable confidence that ecologically significant adverse impacts to aquatic wildlife are not likely to be associated with Site-related constituents detected in the Eastern Drainage or Western Drainage. Although some of the calculated HQs predict adverse impacts to aquatic wildlife, the HQs were considered along with lines of evidence regarding the spatial distribution of chemicals, the available habitat quality, and observations of aquatic wildlife. Based on these multiple lines of evidence, it can be concluded that adverse impacts are not likely to occur in areas with the highest quality habitat. Further, elevated estimates of risk in the pond are not consistent with observations of the biological activity in the pond. Consideration of all available lines of evidence indicates that adverse impacts, if occurring, are not likely to result in population, community, or ecosystem level impacts. Conclusions drawn at the population and community levels are appropriate in this ERA because it has been documented that threatened and endangered species are not present in the vicinity of the Site (USEPA 1999).

4.2 Refined Evaluation of Water/Dietary Exposures and Risks for Piscivorous Wildlife

This section presents the refinement of piscivorous water/dietary COPCs (Section 4.2.1), the refinement of direct contact risk calculations for piscivorous wildlife (Section 4.2.2), and overall conclusions regarding risks to piscivorous wildlife (4.2.3).

4.2.1 Refinement of Piscivorous Water/Dietary COPCs

The refinement of water/dietary prey COPCs is based on four steps, similar to the refinement of direct contact COPCs described in Section 4.1.1: (1) data grouping, (2) identification of SLERA COPCs for each data grouping, (3) refined screening against background and ESVs, and (4) identification of Step 3a COPCs to be carried forward into the refined risk calculations.

(1) Data Groupings – As described in Section 4.1.1, three surface water data groupings are available and used in the refinement of piscivorous water/dietary COPCs: Eastern Drainage-Off Site; Western Drainage-On Site; and Western Drainage-Off Site.

(2) Identification of SLERA COPCs for each Data Grouping – Constituents identified as COPCs in the SLERA (Sections 3.2.1 and 3.4) are carried into the refinement process in the subdivided data sets. For example, any constituent identified as an "off Site piscivorous water/dietary COPC" in the SLERA is identified for both the "Eastern Drainage: Off Site" and the "Western Drainage: Off Site" refinement of COPCs evaluations.

(3) Refined Screening – For each data grouping, refined screening involves consideration of maximum detected concentrations, background concentrations, and SLERA ESVs. Within each data grouping, the EPCs are compared to appropriate background data. It should be noted that calcium, magnesium, potassium, and sodium are not evaluated in this manner because they are essential nutrients, have typically been detected at or less than twice background, and no ESVs are available. For those constituents that have EPCs greater than the background concentrations, the EPCs are then compared to the SLERA ESVs (i.e., the same ESVs used for piscivorous risk calculations in the SLERA (Section 3.2.1)). Constituents were carried forward as Step 3a COPCs when both of the following conditions are met:

- EPCs exceed background (or no background was available), and
- EPCs exceed SLERA ESVs (or no ESV was available).

(4) Identification of Step 3a COPCs - The identification of the Step 3a COPCs is provided for each data grouping using the refinement process described above, on Tables 4-5a through 4-5c, as follows:

- Table 4-5a: Refinement of Piscivorous Water/Dietary COPCs (Eastern Drainage: Off Site)
- Table 4-5b: Refinement of Piscivorous Water/Dietary COPCs (Western Drainage: On Site)
- Table 4-5c: Refinement of Piscivorous Water/Dietary COPCs (Western Drainage: Off Site)

The COPCs carried forward into Step 3a based on the refinement described in this section are:

Summary of Piscivorous COPCs	
Data Grouping	**COPCs**
Off Site Eastern (Table 4-5a)	Cadmium, manganese, sulfate, zinc
On Site Western (Table 4-5b)	Cadmium, sulfate, zinc, cis-1,2-dichloroethene, trichloroethylene
Off Site Western (Table 4-5c)	Aluminum, cadmium, manganese, selenium, sulfate, zinc

4.2.2 Refinement of Piscivorous Risk Calculations

This section describes the process used to refine risk calculations (Section 4.2.2.1), identifies the HQs greater than 1, presents an interpretation of the significance of those HQs (Section 4.2.2.2), identifies the constituents lacking ESVs in this refinement process, provides an interpretation of whether these constituents may be problematic (Section 4.2.2.3), and provides an overall summary of estimated risks to aquatic wildlife (Section 4.2.2.4).

4.2.2.1 Refinement Process

In Step 3a of the BERA, the SLERA risk calculations are refined for piscivorous wildlife exposed to water/dietary prey by recalculating HQs using more realistic estimates of exposure and/or more realistic toxicity values. The recalculation of the HQs is summarized on Tables 4-6a, 4-6b, and 4-6c for the Eastern Drainage-Off Site, Western Drainage-On Site, and Western Drainage-Off Site, respectively.

The refined risk calculations are intended to reflect refined exposure estimates. Therefore, as seen on Tables 4-6a, 4-6b, and 4-6c, EPCs are used in the refined risk calculations. However, it should be noted that the EPCs are the maximum detected concentrations rather than the UCL concentrations (i.e., the UCLs exceeded the maximum concentrations due to the small size of the data sets). An alternative method to evaluate a range of exposure estimates is discussed further in this section on a chemical-specific, location-specific basis.

The refined risk calculations also are based on refined effects estimates. Therefore, refined piscivore risk calculations use ESVs based on both NOAELs, and lowest observable adverse effects levels (LOAELs). The toxicological basis and references for LOAELs are summarized in Appendix D (Table D-1a).

4.2.2.2 Identification and Interpretation of Piscivorous HQs Greater than 1

The COPCs with HQs greater than 1 are summarized on the following table for each data grouping and receptor (constituents with HQs less than or equal to 1 are not discussed further in the BERA). Following the summary, the ranges of HQs, spatial distribution of the elevated HQs, and potential significance to aquatic wildlife are discussed in greater detail (sampling locations are depicted on Figure 2-5a).

Summary of Refined Risk Calculations: HQs Greater than 1

	Eastern Drainage		Western Drainage			
	Off Site (Table 4-6a)		On Site (Table 4-6b)		Off Site (Table 4-6c)	
Constituent	Mink HQs	Heron HQs	Mink HQs	Heron HQs	Mink HQs	Heron HQs
Aluminum					6-60	
Cadmium	2-20	0.8-7	50-500	30-200	8-80	4-30
Selenium					3-5	0.9-2
Zinc	6-10	10-100	10-30	30-300	10-30	30-300

Blank cells indicate either the constituent was not detected or the HQ was less than or equal to 1

HQs are based on maximum detected concentrations, while range shows NOAEL HQ to LOAEL HQ.

As previously stated, the HQs that were calculated for both receptors (i.e. heron and mink) in the refined risk calculations are based on maximum detected concentrations due to small data sets. Therefore, it is extremely unlikely that either receptor would be exposed to maximum detected concentrations on a long-term basis. In reality, heron will only spend a small portion of their time in either the Eastern or Western Drainages, and it is highly unlikely that sufficient aquatic habitat exists to support mink in the vicinity of the Site. Nevertheless, in order to refine and understand potential risks associated with the constituents identified with HQs greater than 1, location-specific HQs are calculated, as follows (and discussed below):

- Table 4-7a: Location-Specific Piscivorous Water/Dietary HQs (Eastern Drainage: Off Site)
- Table 4-7b: Location-Specific Piscivorous Water/Dietary HQs (Western Drainage: On Site)
- Table 4-7c: Location-Specific Piscivorous Water/Dietary HQs (Western Drainage: Off Site)

Eastern Drainage: Off Site – The evaluation of off Site surface water in the Eastern Drainage involved two sampling locations, SW-ED-13 and SW-ED-16. Location ED-13 is adjacent to the Site boundary, while ED-16 is near Lake Hillsboro (figure 2-5a). At location ED-13, the only LOAEL-based HQs greater than the threshold value of 1 are for cadmium (2 for the mink) and zinc (6 for the mink and 10 for the heron). At location ED-16, no HQs were greater than 1. As noted previously, sulfate was detected at concentrations greater than the background concentration at both locations; however, since no NOAELs or LOAELs were available for sulfates, HQs were not calculated.

As described previously, the area of the Eastern Drainage in the vicinity of ED-13 does not have perennial flow, and does not provide mink habitat. Further, fish are rarely going to be present in much of this portion of the drainage, so even the heron will find little forage opportunity. Fish communities, however, may be present in the vicinity of Lake Hillsboro. Note that cadmium and zinc were either not detected at ED-16, or detected at concentrations less than background. Therefore, adverse impacts are not expected for mink or heron in the Eastern Drainage.

Western Drainage: On Site – The evaluation of on Site surface water in the Western Drainage involved three sampling locations (Table 4-7b; Figure 2-5a). The HQs are greater than the threshold value for cadmium and zinc at all three locations. However, adverse impacts are not expected for the mink, because mink are not expected to be exposed to the pond. This is because mink are unlikely to traverse the very shallow tributary and travel overland to reach the pond. Therefore, mink exposure to the pond is highly unlikely.

Adverse impacts to the green heron cannot be ruled out based only on the HQs and consideration of habitat. Green heron have been seen foraging in the pond, and could spend appreciable amounts of time at the pond given the known presence of fish. In addition, the LOAEL HQs for the heron in the pond are 10 for zinc and 10 for cadmium, indicating that adverse impacts to these receptors would be expected for heron that live 100 percent of the time at the pond. These

HQs are based on LOAELs that reflect the reproductive ability of birds exposed to levels of zinc and cadmium. HQs greater than 1 for both zinc and cadmium for the LOAELs indicates that reproductive effects are likely to be observed for heron that feed exclusively in the pond. Specifically, birds exposed exclusively to the pond may lay fewer eggs due to cadmium exposure and eggs may have less hatching success due to zinc exposure (Sample et al. 1996). However, when consideration is given to the percent of time heron are likely to spend at the pond (given heron home ranges and migration patterns) as well as the limited number of heron likely to be exposed, adverse impacts to the heron are not likely to be ecologically significant.

Refinement of the risk calculations involves consideration of reasonable exposure assumptions. Therefore, the percent of time heron are likely to spend at the pond as well as the limited number of heron likely to be exposed needs to be considered. The pond is small, and is unlikely to represent even one heron's entire foraging range. Home ranges for waterfowl vary greatly, and are very dependent on the available aquatic resources of any given area (National Geographic, 1999). Green heron that visit the pond are very likely to forage in on Site and off Site drainages. Further, heron are likely to utilize the higher-quality habitat of Lake Hillsboro and the Bremer Sanctuary. Further, heron, and other piscivorous bird species are migratory, so they are only likely to spend approximately 50 percent of their time in Illinois in any given year (National Audubon Society, 2004). As a result, actual exposure is expected to be much less than that predicted using the HQ calculations. Finally, only a limited number of individual heron are likely to be present at the pond in any given year.

Therefore, considering all of these variables, it is very reasonable to expect that adverse impacts may not occur for green heron that feed in the pond as part of their forage range. Further, even if adverse impacts do occur for an individual green heron that feeds in the pond a disproportionate amount of the time, the adverse impacts are likely to be very isolated, and are not likely to affect heron populations.

<u>Western Drainage: Off Site</u> – The evaluation of surface water in the Western Drainage (off Site) involved four locations, though some were sampled on multiple occasions (Table 4-7b; Figure 2-5a). Cadmium and zinc HQs off Site are most elevated in the area with the least available habitat. The most elevated HQs were seen at location WD-7, a location repeatedly identified as the pond outfall with only a few inches of water and no fish habitat.

The unnamed tributary flowing north toward Middle Fork Shoal Creek does have aquatic habitat that supports fish and piscivorous wildlife (potentially even the mink). Adverse impacts are not expected for piscivorous wildlife because, as seen at location WD-12, cadmium and zinc were detected below background concentrations in this unnamed tributary to Middle Fork Shoal Creek. Similarly, cadmium and zinc were detected below background at location WD-8 in the unnamed tributary south of the Site. Location WD-6 is located near the confluence of the unnamed drainage and the unnamed tributary. Habitat in this residential area is not sufficient to support fish on a perennial basis (as discussed in section 2.1.1 and seen in Photograph A-5w). Three samples were collected from this location [denoted WD-6a, WD-6b, and WD-6bd, for samples collected March 2003, and June 2003 (i.e., a duplicate sample was collected in June 2003)]. HQs greater than 1 were seen for aluminum, selenium, cadmium and zinc. Aluminum and selenium were isolated occurrences, as they were not seen at other locations, so the remainder of this discussion is focused on zinc and cadmium. The zinc results from location WD-6 in June 2003 (4 mg/L for WD-6b, and 3.6 mg/L for WD-6bd) show detected concentrations very similar to background (3.7 mg/L). Table 4-7c shows HQs for location WD-6b and WD-6bd range from 2-4 for the mink and 5-50 for the heron. These HQs for concentrations so comparable to background illustrate the conservative nature of the HQ estimates. Elevated zinc concentrations seen in the WD-6a sample did yield greater HQs ranging from 8-20 for the mink and 20-200 for the heron. But, concentrations seen just three months later show the transient nature of the exposures wildlife may experience. Similarly, elevated cadmium HQs seen from the sample collected in March was reduced in June (though still greater than 1). Exposures to both mink and heron at location WD-6 would be very limited, as water flow at WD-6 is intermittent and does not support fish on an annual basis. In addition, exposures are further limited based on the home range and migratory patterns already discussed for the heron (i.e., the heron will use a variety of habitat for forage, and they migrate a portion of the year). Similar home range issues apply for the mink as well, so the elevated HQs do not reflect the true exposures that are likely to occur. Given this analysis of habitat and HQs, it is very reasonable to expect that adverse impacts are not likely to occur for heron and mink in the Western Drainage off Site.

4.2.2.3 Constituents Lacking ESVs in Piscivorous Risk Calculations

Manganese was detected in two of the data groupings, but could not be evaluated due to the lack of ESVs. Risks associated with manganese is not expected because it is a naturally occurring constituent that was also detected in background locations at concentrations similar to the non-background locations.

4.2.3 Overall Conclusions for Piscivorous Wildlife

Based on the information developed and presented in this section it can be concluded with reasonable confidence that ecologically significant adverse impacts to piscivorous wildlife are not likely to be associated with Site related constituents detected in the Eastern Drainage or the off Site Western Drainage. Although some of the calculated HQs predict adverse impacts to piscivorous wildlife, the HQs were considered along with lines of evidence regarding the spatial distribution of chemicals, the available habitat quality, and observations of aquatic wildlife. Based on these multiple lines of evidence, it can be concluded that adverse impacts to piscivorous wildlife are not likely to occur in the Eastern Drainage or off Site in the Western Drainage.

In the Western Drainage, the on Site stormwater pond presents challenges for understanding potential risks to piscivorous wildlife. Adverse impacts to mink can be ruled out with regard to habitat because, even if mink were present in Middle Fork Shoal Creek and the unnamed tributary, mink are highly unlikely to traverse the very shallow unnamed drainage and travel overland to the pond. As described in Section 2.1.1, the "flow" to the pond is either through the outfall or from seepage under the berm; therefore, there is no direct aquatic connection that a mink could follow. As a result, mink exposure to the pond is highly unlikely. With regard to the green heron, adverse impacts due to potential exposure to the water in the pond cannot be ruled out based on HQs and consideration of habitat alone. However, if more realistic exposure is considered, it is likely that adverse impacts will not occur for heron that feed in the pond because the pond is likely to be a small part of its home range (which would include higher quality habitat in the unnamed tributary, Middle Fork Shoal Creek, Lake Hillsboro, and the Bremer Sanctuary). Further, if adverse impacts do occur for an individual green heron that feeds in the pond a disproportionate amount of the time, the adverse impacts are likely to be very isolated, and would not affect heron populations. Finally, elevated estimates of risk in the pond are not consistent with observations of the biological activity in the pond. Consideration of all available lines of evidence indicates that adverse impacts, if occurring, are not likely to result in population, community, or ecosystem level impacts. As mentioned previously in Section 4.1.3, conclusions drawn at the population and community levels are appropriate in this ERA because it has been documented that threatened and endangered species are not present in the vicinity of the Site (USEPA 1999).

4.3 Refined Evaluation of Food Web Exposures and Risks for Terrestrial Wildlife

This section presents the refinement of terrestrial wildlife COPCs (Section 4.3.1), the refinement of food web risk calculations for terrestrial wildlife (Section 4.3.2), and overall conclusions regarding risks to terrestrial wildlife (4.3.3). Note that data grouping involved a single data set, and subgrouping similar to that seen for aquatic drainages was not required.

4.3.1 Refinement of Terrestrial Food Web COPCs

The refinement of COPCs for terrestrial wildlife is identified on Table 4-8 for each of the three receptor species (i.e., deer mouse, American robin, and red-tailed hawk). Specifically, COPCs are identified for the refinement of risk calculations if both of the following conditions are met (1) the constituent was previously identified in the SLERA for a given receptor, and, (2) surface water or soil EPCs exceed background concentrations. As a result, the COPCs included retained for each receptor based on the considerations just described are:

Summary of Terrestrial Wildlife COPCs

Receptor	COPCs
Deer Mouse	Cadmium, lead, nickel, selenium, zinc
Robin	Cadmium, chromium, lead, mercury, zinc
Hawk	Cadmium, zinc

4.3.2 Refinement of Terrestrial Wildlife Risk Calculations

This section describes the process used to refine risk calculations (Section 4.3.2.1), identifies the HQs greater than 1 with an interpretation of the significance of those HQs (Section 4.3.2.2), and provides an overall summary of estimated risks to terrestrial wildlife (Section 4.3.2.3).

4.3.2.1 Refinement Process

Risk calculations are refined for terrestrial wildlife by recalculating HQs using identical mathematical formulae previously described in the SLERA (Section 3.1.3.1; Appendix D, Tables D-2a, D-2b, and D-2c, for the mouse, robin, and hawk, respectively). Although intake formulae did not change between the SLERA and this BERA, more realistic estimates of exposure and effects than those used in the SLERA were used in this BERA refinement process.

The recalculation of the HQs is summarized on Tables 4-9a, 4-9b, 4-9c for the deer mouse, American robin, and red-tailed hawk, respectively. The exposure and effects assumptions that were included in this refined risk calculation process are described below.

Exposure assumptions – Media concentrations, species-specific wildlife exposure parameters, and bioaccumulation/bioconcentration factors used in this refinement reflect more realistic exposure assumptions than those used in the SLERA, as described follows:

1. The ***media concentrations*** used for the refinement are exposure point concentrations that reflect the upper estimate of the average concentration (i.e., the UCL). These values replace the maximum detected concentrations that were used in the SLERA. The medium-specific exposure estimates used in the refinement are identified on Tables 4-9a, 4-9b, and 4-9c, for the mouse, robin, and hawk.

2. ***Wildlife exposure parameters*** include average estimates of body weight, ingestion rate, dietary parameters, exposure duration, and Site foraging frequency. The exposure parameters used in the SLERA were intentionally conservative to estimate the worst-case exposures, and in the BERA these assumptions are modified to reflect more realistic exposures (USEPA 1997; 2000a; 2001a). For example, average body weights and ingestion rates are used. In addition, home range is used to provide a more realistic estimate of the time a given species may spend at the Site. Similarly, the red-tailed hawk and American robin are known to migrate during winter. Using this information, more realistic exposure durations are estimated. The exposure parameters used, with the rationales for selections and sources cited, are identified in Appendix D (Tables D-3a, D-3b, and D-3c, for the mouse, robin, and hawk, respectively).

3. ***The Bioaccumulation and bioconcentration factors*** used for the refined risk calculations are provided on Tables 4-9a, 4-9b, and 4-9c, for the mouse, robin, and hawk. The values

used are the average values identified by Sample et al. (1998a&b) and Bechtel (1998) rather than the 90 percentile values used in the SLERA (the full compilation of bioaccumulation and bioconcentration factors used in the SLERA and BERA is provided in Appendix D, Table D-4).

Effects Estimates – The refined risk calculations included refining the ecological effects estimates (i.e., the toxicity values). The SLERA considered only NOAELs, which provide insight into concentrations that will cause "no observable adverse effects." This refined analysis includes the same NOAEL values, but also includes LOAEL values, which provides insight into the lowest concentrations that have been identified as being associated with an observable effect.

4.3.2.2 Identification and Interpretation of Terrestrial HQs Greater than 1

The COPCs with HQs greater than 1 are summarized on the following table for each receptor (constituents with HQs less than or equal to 1 are not discussed further in the BERA). Following the summary table, the ranges of HQs, spatial distribution of the elevated HQs, and potential significance to terrestrial wildlife are discussed in greater detail (sampling locations are depicted on Figure 2-5C).

Summary of Refined Risk Calculations: HQs Greater than 1

	Deer Mouse		American Robin		Red-Tailed Hawk	
Constituent	LOAEL HQs	NOAEL HQs	LOAEL HQs	NOAEL HQs	LOAEL HQs	NOAEL HQs
Cadmium	2	20		20		
Zinc	2	3	6	50		3

Blank cells indicate either the constituent was not detected or the HQ was less than or equal to 1

HQs are based on maximum detected concentrations, while range shows LOAEL HQ to NOAEL HQ.

Deer Mouse and American Robin – Adverse impacts are not expected to be ecologically significant for deer mouse and American robin, but there are three specific samples that are giving the impression of more broad based potential effects. Deer mouse HQs range from 2-20 for cadmium and 2-3 for zinc, while robin HQs range from 1-20 for cadmium and 6-50 for zinc. As indicated in Tables D-1b and D-1c, the LOAELs are based on reproductive effects for mammals and birds. LOAEL HQs in the range of 2-6 for deer mice and robins indicates that mammals and birds may be exposed, on average, to concentrations of cadmium and zinc that could cause adverse impacts. These HQs are meaningful because they are based on average exposures, using relatively realistic estimates of exposure and effects. The HQs for cadmium and zinc for both species are most sensitive to (i.e., influenced the most by) soil concentration (ingestion of invertebrates/earthworms actually leads to the elevated HQs, but earthworm tissue concentrations are closely correlated to soil concentrations). A close evaluation of soil concentrations used for this assessment (see Table B-3) shows that there were two samples collected under the residue material that significantly influenced the EPC. These were samples A1-06 and A1-23. These two locations had the two greatest detected zinc concentrations (11,000 mg/kg and 5,700 mg/kg), and two of the three highest cadmium concentrations (87 mg/kg and 56 mg/kg). A third cadmium concentration of 70 mg/kg was seen at location WA-09. These detected cadmium and zinc concentrations are not characteristic of the remainder of the soil data set and lead to an overestimate of risk. It is likely that these skewed analytical results are an artifact of efforts to sample beneath residue and are not indicative of soil concentrations at the Site (i.e., fragments of residue could have been included in the acid-digestion and analysis).

Deer mice and robins are not likely experiencing any current adverse impacts because the soil data set used for this evaluation, including the three elevated results discussed above, are not currently accessible (i.e., they are underneath residue material). Furthermore, the elevated concentrations are not present in areas with suitable wildlife habitat. On the other hand, locations in the Northern Area (NA-08, NA-09, and NA-09D) have zinc and cadmium at concentrations orders of magnitude less than the cadmium and zinc EPCs. Further, the Northern Area is the location with existing habitat; thus, deer mice and robin on Site are currently not likely to be experiencing any significant exposure or impacts. Therefore, based on consideration of data and its spatial distribution at the Site, adverse impacts are not expected to be ecologically significant for deer mouse and American robin.

<u>Red-tailed Hawk</u> – The HQs calculated for the red-tailed hawk are very low (the greatest HQ is a NOAEL-based value of 3 for zinc). Therefore, adverse impacts are not expected for red-tailed hawks that may forage at the Site. Further, adverse impacts are not expected for any other raptor

that forages at the Site, as the red-tailed hawk is assumed to represent a wide range of species within this trophic level.

4.3.3 Overall Conclusions for Terrestrial Wildlife

Significant adverse impacts are not likely for the deer mouse, American robin, or red-tailed hawk.

4.4 Refined Evaluation of Uncertainties

The characterization of uncertainty is a component of the ERA process (USEPA, 1997). This section provides a narrative discussion of the types of uncertainties that exist in an ERA, with a focus (when possible) on how these uncertainties affect the conclusions drawn for the Eagle Zinc Site. Some of these uncertainties were identified previously in the SLERA (Table 3-5), as the general principles apply in both approaches. The difference between the SLERA and BERA, however, is the reduction in uncertainties in the BERA (when possible) through the use of Site-specific information. In addition, while a SLERA is based on the most conservative assumptions in areas where uncertainty exists, a BERA uses more realistic assumptions (USEPA 1997; 2000a; 2001a).

Toxicological Uncertainties - The ERA for the Eagle Zinc Site is based on ecotoxicological benchmarks (e.g., ESVs) such as NOAELs, LOAELs, acute and chronic criteria, probable effects levels, and severe effects levels from a broad range of sources. The use of the range of benchmarks is intended to reduce the uncertainty associated with the conservative SLERA assumptions. However, uncertainties associated with bioavailability and toxicity exist, for example:

- The benchmarks used in the BERA for the Eagle Zinc Site, although less conservative than those used in the SLERA, still do not take into account diminished bioavailability due to mitigating factors such as acid volatile sulfides (AVS) or total organic carbon (TOC). Risks can be significantly overestimated because data related to the AVS and TOC components of sediments at the Eagle Zinc Site are not available for consideration. For example, it is well known that AVS and TOC diminish the bioavailability, and thus toxicity, of metals such as zinc and cadmium (Chapman 1996; Sprague 1985; DiToro 2001, Santoro 2001; Alexander 2000). Most trace metals do not form distinct sulfides but are sorbed onto pyrite and iron monosulfides that have been proved to control the mobility, potential toxicity and ultimate fate of elements such as zinc and cadmium (Morse 1994).

- The USEPA's National Recommended Water Quality Criteria (and ultimately state criteria, such as Illinois) are expressed in terms of the dissolved metal in the water column (NOAA, 1999; USEPA, 2002). According to USEPA, "concentrations of dissolved metals rather than total metals should be used to set and measure compliance with water quality standards" because dissolved metals are considered the biologically available fraction (USEPA, 1996). Metals that are not biologically available, but may be detected in total metals analyses, do not cause toxicity to aquatic organisms and do not readily bioaccumulate in aquatic organisms (Newman, 1998). Dissolved metals data are not available for the Eagle Zinc Site; thus, the degree to which aquatic organisms (and fish and piscivorous wildlife) are actually exposed is unknown. However, because dissolved metals are always a fraction of total metals, one can generally assume that exposures estimated using total metals data exceeds actual exposures, thereby overestimating risks.
- Tolerance and adaptation are not considered directly in the BERA, though it is well known that biological organisms have the capacity to tolerate elevated conditions and adapt to an environment when exposed on a long-term basis (Millward and Klerks 2002; Grant 2002). The presence of fish and other aquatic wildlife in the Western Drainage stormwater pond where HQs predicted adverse impacts may be an example of tolerance and adaptation, an indication of diminished bioavailability, or both.

Uncertainties in toxicological data do not always lead to the an overestimation of risks, as there are some uncertainties for which the effect on the risk assessment process is unknown. For example, the field of ecotoxicology has not developed to a point that allows characterization of ecological risks with a high degree of certainty (Kapustka and Landis, 1998; Newman, 1998; Lovett Doust, et al., 1993). Uncertainty is inherent in conclusions drawn based on the use of these values, in part, because the science of ecotoxicology is relatively young and not yet fully developed. Toxicity data are only available for a limited number of species (most of them laboratory test species) under a defined set of test conditions (which very likely deviate from natural conditions). In current practice, more than 95 percent of the resources in toxicology are focused toward the study of single chemicals (Cassee, et al. 1998), and the majority of these are focused toward single species (Sample et al. 1996; Newman 1998). Most of the single chemical/single species testing is performed under highly controlled laboratory conditions, which are very likely deviate from conditions at any Site. Furthermore, simplistic extrapolations from laboratory species to wildlife species and testing conditions to field conditions may not be accurate, and are rarely, if ever, validated against natural conditions (Power 1996).

Some uncertainties in toxicological data also lead to the underestimate of risk. For example, a chemical-specific ERA cannot evaluate risks from all chemicals due to the lack of benchmarks for some of those chemicals. However, the situation was not a major factor at the Eagle Zinc Site due to the nature of the chemicals for which benchmarks were not available (i.e., primarily nutrients).

Risk Characterization Uncertainties - There are uncertainties associated with interpreting individual versus population level impacts using HQs. HQs provide some insight into the types of impacts an individual organism may experience when exposed to chemicals, but they do not provide insight into population impacts (Sorensen et al. 2004). A population is considered the smallest ecological unit that persists through time (Durda and Prezoisi, 1999), and the USEPA requires protection of population, communities, and ecosystems (USEPA, 1999). Protection of individuals is only specifically required for threatened and endangered species (USFWS 1973; USEPA 1999). Estimates of impacts on populations and communities at the Eagle Zinc Site were inferred based on consideration of HQs within the context of habitat quality and wildlife habitat use characteristics. Because it has been documented that threatened and endangered species are not present on Site, protection of populations and communities are appropriate for the Site. Therefore, the elevated HQs were interpreted within the context of habitat quality and wildlife use of the resources on Site. By understanding these interactions, one can begin to interpret HQs with regard to potential-population level impacts (if any).

4.5 Scientific Management Decision Point

As previously mentioned, SMDPs represent critical steps along the process where multi stakeholder risk management decision-making occurs. It is at the SMDPs where the salient aspects of the ecological risk assessment are integrated in a manner that allows for informed risk management. Therefore, it is useful at this point to reiterate the critical context and findings of this ecological risk screening evaluation and, on those bases, provide a conclusion for the Eagle Zinc Site. Specifically:

- Threatened and endangered species are not present at or in the vicinity of the Site.
- Adverse impacts associated with surface water and sediment exposures are predicted, typically in areas with poor habitat characteristics, and/or of limited spatial extent.

- Adverse impacts associated with soil exposures are not likely.
- Observations by biologists and ecologists during multiple Site reconnaissance activities did not result in the identification of adverse ecological impacts to individuals, populations, or communities.

Based on this information, the few exposure scenarios where adverse impacts are predicted are not indicative of ecologically significant impacts to populations, communities, or ecosystems (a primary risk management consideration according to USEPA [1999]). Therefore, it is concluded that the available information is adequate to decide that ecological risks are negligible at the Eagle Zinc Site and, therefore, there is no need for further action on the basis of ecological risk.

5.0 REFERENCES

Alexander, M. 2000. Aging, bioavailability, and overestimation of risk from environmental pollutants, *Environmental Science and Technology*, 34(20)4259-4265.

Atchison, G.J., M.B. Sandheinrich, and M.D. Bryan. 1996. Effects of environmental stressors on interspecific interactions of aquatic animals. Pp.319-337. In: Ecotoxicology – A Hierarchical Treatment. Newman, M.C., and C.H. Jagoe, eds., CRC Press, Inc., Boca Raton, FL.

Bechtel. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel Jacobs Company, LLC. September.

Cassee, F. R., Groten, J.P., vanBladeren, P.J., and Feron, V.J. 1998. Toxicological Evaluation and risk assessment of chemical mixtures. Critical Reviews in Toxicology, 28(1):73-101.

CH2MHill. 2004 – Technical Memorandum: Approach for Assessment of On-Site Ecological Receptors at the Eagle Zinc Site. Submitted to US Environmental Protection Agency, Region V (Dion Novak) by CH2MHill (Ryan Loveridge and Steve Petron). June 7.

Chapman, P.M., H.E. Allen, K. Godtfredsen, and M.N. Z'Graggen 1996. Evaluation of bioaccumulation factors in regulating metals. Environ. Sci. Technol. Vol. 30, pp. 448A-452B.

Di Toro, D.M., H.E. Allen, H.L. Bergman, J.S. Meyer, P.R. Paqiun, and R.C. Santore. 2001. "A biotic ligand model of the acute toxicity of metals. I. Technical basis." Environ. Tox. Chem. 20: 2383-2396.

Durda, J.L., and D.V. Preziosi. 1999. Where's the population in your risk assessment? *SETAC News*, Volume 19, Number 6, November.

ENVIRON International Corporation. 2002a. Remedial Investigation/Feasibility Study Work Plan. Remedial Investigation/ Feasibility Study for the Eagle Zinc Company Site, Hillsboro, Illinois. July 2002.

ENVIRON International Corporation. 2002b. Preliminary Site Evaluation Report: Remedial Investigation/Feasibility Study Eagle Zinc Company Site, Hillsboro, Illinois. Submitted to US Environmental Protection Agency, Region V and Illinois Environmental Protection Agency on behalf of Eagle Zinc Group.

ENVIRON International Corporation. 2003a. Technical Memorandum Remedial Investigation Phase I: Source Characterization, Remedial Investigation/Feasibility Study Eagle Zinc Company Site, Hillsboro, Illinois. Submitted to US Environmental Protection Agency, Region V and Illinois Environmental Protection Agency on behalf of Eagle Zinc Group.

ENVIRON International Corporation. 2003b. Technical Memorandum Remedial Investigation Phase 2: Migration Pathway Assessment, Remedial Investigation/Feasibility Study Eagle Zinc Company Site, Hillsboro, Illinois. Submitted to US Environmental Protection Agency, Region V and Illinois Environmental Protection Agency on behalf of Eagle Zinc Group.

ENVIRON International Corporation. 2004. Draft Screening Level Ecological Risk Assessment Response to USEPA Comments. Letter Submitted to US Environmental Protection Agency, Region V and Illinois Environmental Protection Agency on behalf of Eagle Zinc Group. July 15.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York, New York.

Grant, A. 2002. Pollution-tolerant species and communities: intriguing toys or invaluable monitoring tools? *Human and Ecological Risk Assessment,* 8(5)95-970.

Illinois Environmental Protection Agency (IEPA). 1997. Evaluation of Illinois Sieved Stream Sediment Data; 1982-1995. August.

Illinois Pollution Control Board. 2002a. Title 35 of the Illinois Administrative Code, Subtitle C: Water Pollution. Part 302, Subpart B. General Use Water Quality Standards Section 302:208. http://www.ipcb.state.il.us/SLR/IPCBandIEPAEnvironmentalRegulations-Title35.asp

Illinois Pollution Control Board. 2002b. Title 35 of the Illinois Administrative Code, Subtitle C: Water Pollution. Part 302, Subpart F. Listing of Derived Criteria. Section 302:669. http://www.epa.state.il.us/water/water-quality-standards/water-quality-criteria.html

Ingersoll, C.G., D.D. MacDonald, n. Wang, J. Crane, L.J. Field, P.S. Haverland, N.E. Kenmble, R.A. Lindskoog, C. Severn, and D.E. Smorong. 2000. Prediction of Sediment Toxicity Using Consensus-Based Freshwater Sediment Quality Guidelines. U.S. Geological Service. June.

Kapustka, L.A., and W.G. Landis. 1998. Ecology: the science versus the myth. Human and Ecological Risk Assessment 4(4):829-838.

Kelly, M.H. and R.L. Hite. 1984. Evaluation of Illinois Stream Sediment Data, 1974-1980. IEPA/WPC/84-004. IEPA. Springfield, IL. *As cited in:* IEPA, 1997.

Leland, H.V., and Kuwabara, J.S. 1985. Trace Metals. Fundamentals of Aquatic Toxicology. Rand, G.M., and Petrochelli, S.R., eds. Taylor and Francis Publishing.

Lovett Doust, J., Schmidt, M., and Lovett Doust. 1993. Biological assessment of aquatic pollution: Review, with emphasis on plants as biomonitors. Ecological Review, 69(2)147-187.

Millward, R. and P. Klerks. 2002. Contaminant-adaptation and community tolerance in ERA: Introduction. *Human and Ecological Risk Assessment*, 8(5)921-932.

Morse, J.W., 1994, Interactions of trace metals with authigenic sulfide minerals: implications for their bioavailability. Marine Chemistry, 46, 1-6.

National Audubon Society, 2004. "The Green Heron." http://www.audubon.org/bird/BoA/F38_G1e.html

National Geographic, 1999. Field guide to the birds of North America, Third Edition.

National Oceanographic and Atmospheric Administration. 1999.

Newman, M. 1998. Fundamentals of Ecotoxicology. Ann Arbor Press, Ann Arbor, Michigan.

Ohio Department of Natural Resources. 2004. *Catalpa speciosa.* http://www.dnr.state.oh.us/forestry/Education/ohiotrees/catalpa.htm

Ontario Ministry of the Environment (OME), 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment and Energy, (Persaud, D., R. Jaagaumagi and A. Hayton), ISBN 0-7729-9248-7.

Power, M. 1996. Probability concepts in ecological risk assessment. Human and Ecological Risk Assessment, 2(4):650-654.

Risk Science International. 1982. Environmental Risk Assessment Prepared for The Sherwin-Williams Corporation, The Hillsboro, Illinois Facility. November 24, 1982.

Sample, B. E., and Suter II, G. W, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. ES/ER/TM-125

Sample, B.E, J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, T.L. Ashwood. 1998a. Development and Validation of Bioaccumulation Models for Earthworms. February.

Sample, B.E, J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II. 1998a. Development and Validation of Bioaccumulation Models for Small Mammals. February.

Sample, B.E., D.M. Opresko, and G.W. Suter II. Toxicological Benchmarks for Wildlife: 1996 Revisions. Prepared by the Risk Assessment Program, Health Sciences Research Division, Oak Ridge National Laboratory for the U.S. Department of Energy. ES/ER/TM-86/R3.

Santore, R.C., D.M. Di Toro, P.R. Paqiun, H.E. Allen, and J.S. Meyer. 2001. "A biotic ligand model of the acute toxicity of metals. II. Application to acute copper toxicity in freshwater fish and daphnia." Environ. Tox. Chem. 20: 2397-2402.

Sorensen, MT, Gala, WR, Margolin, JA. 2004. Approaches to ecological risk characterization and management: selecting the right tools for the job. Hum Ecol Risk Assess 10:245-269.

Sprague, J.B. .1985. .Factors that Modify Toxicity.. In: Fundamentals of Aquatic Toxicity. Eds. Rand G.M. and S.R. Petrocelli, Hemisphere Publishing Co., Washington D.C.

Suter, G.W., Cornaby, B.W., Hadden, C.T., Hull, R.N., Stack, M., and Zafran, F.A. 1995. An approach for balancing health and ecological risks at hazardous waste facilities. Risk Analysis, vol. 15, no. 2, pp. 221-231.Suter II, G. W. and C. L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. 1996 Revision.* ES/ER/TM-96/R2.

Tannenbaum, L. 2003. Can ecological receptors really be at risk? *Journal of Human and Ecological Risk Assessment.* 9(1)5-13.

U.S. Department of Agriculture. 2004. *Catalpa speciosa.* Natural Resources Conservation Service. http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=casp8

U.S. Environmental Protection Agency (USEPA). 1993. Wildlife Exposure Factors Handbook. Volume I of II. EPA/600/R-93/187.

U.S. Environmental Protection Agency (USEPA). 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Solid Waste and Emergency Response. EPA 540-R-97-006.

U.S. Environmental Protection Agency (USEPA). 1998. Guidelines for Ecological Assessment. Office of Research and Development, EPA/630/R-95/002FA, April 1998.

U.S. Environmental Protection Agency (USEPA). 2000a. Amended Guidance on Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders. Memorandum from Simon, Ted. W., Ph.D., Office of Technical Services. http://risk.lsd.ornl.gov/homepage/ecoproc2.pdf

U.S. Environmental Protection Agency (USEPA). 2000b. Region 4 Ecological Risk Assessment Bulletins – Supplement to RAGS. Accessed 2001. http://www.epa.gov/region4/waste/ots/ecolbul.htm

U.S. Environmental Protection Agency (USEPA). 2000c. Bioaccumulation Testing and Interpretation For the Purpose of Sediment Quality Assessment – Status and Needs. Office of Water. Office of Solid Waste. EPC-823-R-00-001. February.

U.S. Environmental Protection Agency (USEPA). 2001a. ECO-Update: Role of Screening-level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments. http://www.epa.gov/superfund/programs/risk/ecoup/slera0601.pdf

U.S. Environmental Protection Agency (USEPA). 1999 Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites. OSWER Directive 9285.7-28 P.

U.S. Environmental Protection Agency (USEPA). 2001b. Planning for Ecological Risk Assessment: Developing Management Objectives. Risk Assessment Forum, Office of Research and Development. EPA/630/R-01/001A.

U.S. Environmental Protection Agency (USEPA). 2002. National Recommended Water Quality Criteria: 2002. Office of Water, Office of Science and Technology. EPC-822-R-02-047.

U.S. Environmental Protection Agency (USEPA). 2003a. Integrated Risk Information System (IRIS). http://www.epa.gov/iriswebp/iris/index.html

U.S. Environmental Protection Agency (USEPA). 1996. ECO Update – Ecotox Thresholds. EPA-540-F-95/038 http://www.epa.gov/region1/superfund/Sites/central/3285.pdf)

U.S. Environmental Protection Agency (USEPA). 2003b. Region V Ecological Screening Levels. http://www.epa.gov/Region5/rcraca/edql.htm

U.S. Fish and Wildlife Service, 1988. National Wetland Inventory (NWI). www.fws.gov

U.S. Fish and Wildlife Service (USFWS). 1973. "Endangered Species Act". Amended in 1978, 1982, and 1988. CFR 50. http://endangered.fws.gov/esa.html

TABLES

Table 2-1a
Summary of Surface Water Ecotoxicity Screening Values
Eagle Zinc
Hillsboro, Illinois

Constituent	Illinois (a) Acute (mg/L)	Illinois (a) Chronic (mg/L)	NRWQC (b) Acute (mg/L)	NRWQC (b) Chronic (mg/L)	Suter and Tsao (c) 2CV (mg/L)	Region IV (d) Acute (mg/L)	Region IV (d) Chronic (mg/L)	Region V (e) ESL (mg/L)	SLERA ESV (f) (mg/L)	
Metals										
Aluminum	---	---	0.75	0.087	---	0.75	0.087	---	0.087	NRWQC
Antimony	---	---	---	---	0.03	1.3	0.16	0.08	0.03	2CV
Arsenic	0.36	0.19	0.34	0.15	0.0031	0.36	0.19	0.148	0.19	ILH2O
Barium	---	---	---	---	0.004	---	---	0.22	0.004	2CV
Beryllium	---	---	---	---	0.00066	0.016	0.00053	0.0036	0.00066	2CV
Cadmium	0.0361	0.00261	0.002	0.00025	---	0.00179	0.00066	0.00015	0.00261	ILH2O
Calcium	---	---	---	---	---	---	---	---	---	
Chromium	0.016	0.011	0.016	0.011	0.002	0.016	0.011	0.042	0.011	ILH2O
Cobalt	---	---	---	---	0.023	---	---	0.024	0.023	2CV
Copper	0.0558	0.0334	0.013	0.009	---	0.00922	0.00654	0.00158	0.0334	ILH2O
Iron	---	---	---	1	---	---	1	---	1	NRWQC
Lead	0.289	0.0607	0.065	0.0025	---	0.03378	0.00132	0.00117	0.0607	ILH2O
Magnesium	---	---	---	---	---	---	---	---	---	
Manganese	---	---	---	---	0.12	---	---	---	0.12	2CV
Mercury	0.0022	0.0011	0.0014	0.00077	0.0013	0.0024	0.000012	0.0000013	0.0011	ILH2O
Nickel	0.0851	0.0145	0.47	0.052	---	0.789	0.08771	0.0289	0.0145	ILH2O
Potassium	---	---	---	---	---	---	---	---	---	
Selenium	---	---	---	0.005	---	0.02	0.005	0.005	0.005	NRWQC
Silver	---	---	---	---	0.00036	0.00123	0.000012	0.00012	0.00036	2CV
Sodium	---	---	---	---	---	---	---	---	---	
Sulfate	---	---	---	---	---	---	---	---	---	
Thallium	---	---	---	---	0.012	0.14	0.004	0.01	0.012	2CV
Vanadium	---	---	---	---	0.02	---	---	0.012	0.02	2CV
Zinc	0.302	0.062	0.12	0.12	---	0.06504	0.05891	0.0657	0.062	ILH2O
Organics										
cis-1,2-Dichloroethene	---	---	---	---	0.59	---	---	---	0.59	2CV
Trichloroethylene	---	---	---	---	0.047	---	---	0.047	0.047	2CV

Notes:

(highlighted)	Criterion is used as the SLERA ESV.
---	Screening criterion is not available.
2CV	Secondary Chronic Value.
ESL	Ecological Screening Level.
ESV	Ecotoxicity Screening Value.
ILH2O	Illinois Water Quality Criteria.
mg/L	Milligrams per liter.
NRWQC	National Recommended Water Quality Criteria.
SLERA	Screening level ecological risk assessment.

(a) Illinois Register, Pollution Control Board, Notice Of Proposed Amendments, Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board, Part 302 Water Quality Standards, 2002. (See Table 2-1b for the calculation of the cadmium, copper, lead, nickel, and zinc criteria).

(b) USEPA Office of Water, 2002. National Recommended Water Quality Criteria.

(c) Suter II, Tsao, 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. USDOE/ORNL. Secondary Chronic Values are shown.

(d) USEPA Region IV, 2000. Amended Guidance on Ecological Risk Assessment at Military Bases.

(e) USEPA Region V, 2003. Ecological Screening Levels.

(f) Values are selected based on the following hierarchy: the State of Illinois, NRWQC, Suter and Tsao, Region IV, Region V.

Table 2-1b
Illinois Water Quality Standards Hardness Based Screening Value Calculations
Eagle Zinc
Hillsboro, Illinois

These equations were used to calculate the Illinois Numeric Water Quality Standards for the Protection of Aquatic Organisms. They are from the Proposed Amendments (dated 2002) to Title 35, Subtitle C, Chapter 1, Part 302 Water Quality Standards. (Available on the web at: http://www.ipcb.state.il.us/Archive/dscgi/ds.py/Get/File-15409/ Proposed_Changes_for_Part_302.pdf).

$$\text{Acute Dissolved Cd} = e^{(-2.918+(1.128\times \ln(H)))}\times(1.138672-(\ln(H)\times 0.041838))$$

$$\text{Chronic Dissolved Cd} = e^{(-3.490+(0.7852\times \ln(H)))}\times(1.101672-(\ln(H)\times 0.041838))$$

$$\text{Acute Dissolved Cu} = e^{(-1.464+(0.9422\times \ln(H)))}\times 0.960$$

$$\text{Chronic Dissolved Cu} = e^{(-1.465+(0.8545\times \ln(H)))}\times 0.960$$

$$\text{Acute Dissolved Pb} = e^{(-1.301+(1.273\times \ln(H)))}\times(1.46203-(\ln(H)\times 0.145712))$$

$$\text{Acute Dissolved Pb} = e^{(-1.301+(1.273\times \ln(H)))}\times(1.46203-(\ln(H)\times 0.145712))$$

$$\text{Chronic Dissolved Pb} = e^{(-2.863+(1.273\times \ln(H)))}\times(1.46203-(\ln(H)\times 0.145712))$$

$$\text{Acute Dissolved Ni} = e^{(0.5173+(0.8460\times \ln(H)))}\times 0.998$$

$$\text{Chronic Dissolved Ni} = e^{(-2.286+(0.8460\times \ln(H)))}\times 0.997$$

$$\text{Acute Dissolved Zn} = e^{(0.8875+(0.8473\times \ln(H)))}\times 0.978$$

$$\text{Chronic Dissolved Zn} = e^{(-0.8227+(0.8473\times \ln(H)))}\times 0.986$$

Where:

e	Euler's number (2.718281828459045 or $e^{\ln(x)} = x$).
H	Hardness in mg/L (see below, the average hardness of 353 mg/L was used).
ln	Natural logarithm.

The output of this equation is the water quality criterion, in micrograms per liter (µg/L).

Table 2-1b

Illinois Water Quality Standards Hardness Based Screening Value Calculations

Eagle Zinc

Hillsboro, Illinois

The hardness of the surface water samples can be calculated from the concentrations of calcium and magnesium in the surface water by this equation (1989, American Public Health Association, Standard Methods for the Examination of Water and Wastewater).

$$\text{Hardness } \frac{mg}{L} = \left(\left[\text{Ca in } \frac{mg}{L}\right] \times 2.497\right) + \left(\left[\text{Mg in } \frac{mg}{L}\right] \times 4.116\right)$$

The Illinois calculations are based on toxicity data similar to the National Recommended Water Quality Criteria (USEPA, 2002). The USEPA guidance states "The hardness equations included in this compilation were developed based on results from laboratory toxicity tests that were conducted in fresh waters encompassing a range of hardness values. Although the amount of data and the strength of the relationship vary for different metals, almost all data for hardness and toxicity are in the 20 to 400 mg/L hardness range. ... If hardness is over 400 mg/L as $CaCO_3$, USEPA continues to recommend that a hardness of 400 mg/L be used." The average hardness of this dataset is less than 400 mg/L, so it will be used in the criteria calculation.

	Sample	Calcium (mg/L)	Magnesium (mg/L)	Hardness (mg/L)
Background	SW-ED-11	88	12	269
Background	SW-WD-11	38	11	140
Background	SW-WD-10	100	26	357
	SW-ED-13	80	27	311
	SW-ED-16	42	14	162
	SW-WD-6a	150	36	523
	SW-WD-6b	90	25	328
	SW-WD-6bd	86	23	309
	SW-WD-12	51	14	185
	SW-WD-7	140	31	477
	SW-WD-7D	140	31	477
	SW-WD-8	130	27	436
	SW-WD-9	120	38	456
	SW-WD-PN	120	38	456
	SW-WD-PS	110	33	410
			Average	353

Using the value above for hardness (353 mg/L) with the equations above to generates the following screening level criteria:

	Acute Criteria		Chronic Criteria	
	(µg/L)	(mg/L)	(µg/L)	(mg/L)
Cd =	36.1	0.0361	2.61	0.00261
Cu =	55.8	0.0558	33.4	0.0334
Pb =	289	0.289	60.7	0.0607
Ni =	85.1	0.0851	14.5	0.0145
Zn =	302	0.302	62	0.062

Table 2-2
Summary of Sediment Ecotoxicity Screening Values
Eagle Zinc
Hillsboro, Illinois

Constituent	Region IV (a) (mg/kg)	Region V (b) (mg/kg)	NOAA (c) (mg/kg) TEL	PEL	UET	USGS (d) (mg/kg) PEL	SEL	TET	ERM	PEC	OMOE (e) (mg/kg) SEL	LEL	SLERA ESV (f) (mg/kg)	
Metals														
Aluminum	---	---	---	---	---	---	---	---	---	---	---	---	---	
Antimony	12	---	---	---	---	---	---	---	---	---	---	---	12	RIV
Arsenic	7.24	9.79	5.9	17	170	17	33	17	85	33	33	6	7.24	RIV
Barium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Beryllium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Cadmium	1	0.99	596	3.53	3	3.53	10	3	9	4.98	10	0.6	1	RIV
Calcium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Chromium	52.3	43.4	37.3	90	95	90	110	100	145	111	110	26	52.3	RIV
Cobalt	---	50	---	---	---	---	---	---	---	---	---	---	50	RV
Copper	18.7	31.6	35.7	197	86	197	110	86	390	149	110	16	18.7	RIV
Iron	---	---	---	---	---	---	---	---	---	---	40,000	20,000	20,000	OMOE
Lead	30.2	35.8	37	91.3	127	91.3	250	170	110	128	250	31	30.2	RIV
Magnesium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Manganese	---	---	---	---	---	---	---	---	---	---	1,100	460	460	OMOE
Mercury	0.13	0.174	0.174	0.486	0.56	0.486	2	1	1.3	1.06	2	0.2	0.13	RIV
Nickel	15.9	22.7	18	35.9	43	36	75	61	50	48.6	75	16	15.9	RIV
Potassium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Selenium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Silver	2	0.5	---	---	---	---	---	---	---	---	---	---	2	RIV
Sodium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Vanadium	---	---	---	---	---	---	---	---	---	---	---	---	---	
Zinc	124	121	123.1	315	520	315	820	540	270	459	820	120	124	RIV
Organics														
2-Butanone	---	---	---	---	---	---	---	---	---	---	---	---	---	
Acetone	---	0.0099	---	---	---	---	---	---	---	---	---	---	0.0099	RV
cis-1,2-Dichloroethene	---	---	---	---	---	---	---	---	---	---	---	---	---	
trans-1,2-Dichloroethene	---	0.654	---	---	---	---	---	---	---	---	---	---	0.654	RV
Trichloroethylene	---	0.112	---	---	---	---	---	---	---	---	---	---	0.112	RV
Vinyl Chloride	---	0.202	---	---	---	---	---	---	---	---	---	---	0.202	RV

Table 2-2
Summary of Sediment Ecotoxicity Screening Values
Eagle Zinc
Hillsboro, Illinois

Notes:

(yellow box)	Criterion is used as the screening criterion.	PEL	Probable effects level.
---	Screening criterion is not available.	RIV	USEPA Region IV.
ERM	Effects range median.	RV	USEPA Region V.
ESV	Ecotoxicity Screening Value.	SEL	Severe effects level.
LEL	Lower effects level.	SLERA	Screening level ecological risk assessment.
mg/kg	Milligrams per kilogram.	TEL	Threshold effects level.
OMOE	Ontario Ministry of the Environment.	TET	Toxic effects threshold.
PEC	Probable effects concentration.	UET	Upper effects threshold.
		USGS	United States Geological Survey.

(a) USEPA Region IV, 2000. Amended Guidance on Ecological Risk Assessment at Military Bases.
(b) USEPA Region V, 2003. Ecological Screening Levels.
(c) NOAA, 1999. Screening Quick Reference Tables (SQuiRT). Probable Effects Level.
(d) Ingersoll & MacDonald et al., 2000. Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines. USGS report for USEPA 905/R-00/007.
(e) Ontario Ministry of the Environment, 1993. Guidelines For The Protection And Management Of Aquatic Sediment Quality In Ontario.
(f) Values are selected based on the following hierarchy: Region IV, Region V, NOAA TEL, USGS PEC, OMOE LEL.

Table 2-3
Summary of SLERA Water/Dietary and Food Web Ecotoxicity Screening Values
Eagle Zinc
Hillsboro, Illinois

Constituent	Most Sensitive Piscivore (a) NOAEL-Based Benchmark (mg/L)	Deer Mouse (a) NOAEL (mg/kg BW-day)	Avian (a) NOAEL (mg/kg BW-day)
Metals			
Aluminum	0.025	---	---
Antimony	0.22	---	---
Arsenic	0.022	0.15	2.46
Barium	---	---	---
Beryllium	0.188	---	---
Cadmium	0.0004367	2.12	1.45
Calcium	---	---	---
Chromium	4.947	6,020	1
Cobalt	---	---	---
Copper	0.294	33.4	47
Iron	---	---	---
Lead	0.142	17.6	3.85
Magnesium	---	---	---
Manganese	---	---	---
Mercury	0.000001305	2.86	0.45
Nickel	2.104	87.9	77.4
Potassium	---	---	---
Selenium	0.0004318	0.44	0.5
Silver	---	48.8	17
Sodium	---	---	---
Sulfate	---	---	---
Thallium	NA	---	---
Vanadium	---	---	---
Zinc	0.085	352	14.5
Organics			
cis-1,2-Dichloroethene	---	---	---
Trichloroethylene	---	---	---

Notes:

--- Not available.
mg/kg BW-day Milligrams per kilogram bodyweight per day.
mg/L Milligrams per liter.
NOAEL No Observed Apparent Effects Level.
SLERA Screening level ecological risk assessment.

(a) Detailed description of the water/dietary food web ecotoxicity screening values is provided in Appendix D.

Table 3-1a
On Site Surface Water Direct Contact SLERA Risk Calculations and Identification of COPCs
Eagle Zinc
Hillsboro, Illinois

Constituent	Maximum Concentration in Surface Water (a) (mg/l)	Surface Water ESV (b) (mg/l)	Surface Water HQ (c) (unitless)	Surface Water COPC? (d) (yes/no)	Rationale (e)
Inorganics					
Aluminum	0.037	0.087	0.4	no	HQ ≤ 1
Barium	0.041	0.004	10	YES	HQ > 1
Cadmium	0.23	0.00261	90	YES	HQ > 1
Calcium	120	---	NA	YES	No ESV
Cobalt	0.0024	0.023	0.1	no	HQ ≤ 1
Copper	0.0026	0.0334	0.08	no	HQ ≤ 1
Iron	0.17	1	0.2	no	HQ ≤ 1
Lead	0.0032	0.0607	0.05	no	HQ ≤ 1
Magnesium	38	---	NA	YES	No ESV
Manganese	0.3	0.12	3	YES	HQ > 1
Nickel	0.036	0.0145	2	YES	HQ > 1
Potassium	17	---	NA	YES	No ESV
Sodium	57	---	NA	YES	No ESV
Sulfate	450	---	NA	YES	No ESV
Zinc	26	0.062	400	YES	HQ > 1
Organics					
cis-1,2-Dichloroethene	0.0000022	0.59	0.000004	no	HQ ≤ 1
Trichloroethylene	0.0000063	0.047	0.0001	no	HQ ≤ 1

Notes:

(yellow box)	HQ > 1	HQ	Hazard Quotient.
---	Not available.	mg/l	Milligrams per liter.
COPC	Chemical of Potential Concern.	NA	Not applicable.
ESV	Ecotoxicity Screening Value.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-2a.
(b) The surface water ESVs are summarized on Table 2-1a.
(c) The HQ is the ratio of the constituent concentration to the appropriate ESV. HQs are rounded to 1 significant digit.
(d) A constituent is considered a COPC if it generates a HQ > 1 or if there is no ESV for that constituent.
(e) This explains why a constituent is (or is not) considered a COPC.

Table 3-1b
Off Site Surface Water Direct Contact SLERA Risk Calculations and Identification of COPCs
Eagle Zinc
Hillsboro, Illinois

Constituent	Maximum Concentration in Surface Water (a) (mg/l)	Surface Water ESV (b) (mg/l)	Surface Water HQ (c) (unitless)	Surface Water COPC? (d) (yes/no)	Rationale (e)
Inorganics					
Aluminum	1.4	0.087	20	YES	HQ > 1
Antimony	0.00032	0.03	0.01	no	HQ ≤ 1
Arsenic	0.0022	0.19	0.01	no	HQ ≤ 1
Barium	0.089	0.004	20	YES	HQ > 1
Beryllium	0.00018	0.00066	0.3	no	HQ ≤ 1
Cadmium	0.034	0.00261	10	YES	HQ > 1
Calcium	150	---	NA	YES	No ESV
Chromium	0.0018	0.011	0.2	no	HQ ≤ 1
Cobalt	0.0016	0.023	0.07	no	HQ ≤ 1
Copper	0.0049	0.0334	0.1	no	HQ ≤ 1
Iron	3.2	1	3	YES	HQ > 1
Lead	0.0052	0.0607	0.09	no	HQ ≤ 1
Magnesium	36	---	NA	YES	No ESV
Manganese	0.62	0.12	5	YES	HQ > 1
Mercury	0.00003	0.0011	0.03	no	HQ ≤ 1
Nickel	0.019	0.0145	*1*	no	HQ ≤ 1
Potassium	9.2	---	NA	YES	No ESV
Selenium	0.002	0.005	0.4	no	HQ ≤ 1
Silver	0.00006	0.00036	0.2	no	HQ ≤ 1
Sodium	60	---	NA	YES	No ESV
Sulfate	330	---	NA	YES	No ESV
Vanadium	0.0051	0.02	0.3	no	HQ ≤ 1
Zinc	26	0.062	400	YES	HQ > 1

Notes:

(yellow box)	HQ > 1	ESV	Ecotoxicity Screening Value.
1	HQ is between 1.0 and 1.5.	HQ	Hazard Quotient.
---	Not available.	mg/l	Milligrams per liter.
COPC	Chemical of Potential Concern.	NA	Not applicable.
		SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-2b.
(b) The surface water ESVs are summarized on Table 2-1a.
(c) The HQ is the ratio of the constituent concentration to the appropriate ESV. HQs are rounded to 1 significant digit.
(d) A constituent is considered a COPC if it generates a HQ > 1 or if there is no ESV for that constituent.
(e) This explains why a constituent is (or is not) considered a COPC.

Table 3-2a
On Site Sediment Direct Contact SLERA Risk Calculations and Identification of COPCs
Eagle Zinc
Hillsboro, Illinois

Constituent	Maximum Concentration in Sediment (a) (mg/kg)	Sediment ESV (b) (mg/kg)	Sediment HQ (c) (unitless)	Sediment COPC? (d) (yes/no)	Rationale (e)
<u>Metals</u>					
Aluminum	7,600	---	NA	YES	No ESV
Antimony	2.1	12	0.2	no	HQ ≤ 1
Arsenic	7.9	7.24	*1*	no	HQ ≤ 1
Barium	82	---	NA	YES	No ESV
Beryllium	0.67	---	NA	YES	No ESV
Cadmium	550	1	600	YES	HQ > 1
Calcium	2,400	---	NA	YES	No ESV
Chromium	17	52.3	0.3	no	HQ ≤ 1
Cobalt	11	50	0.2	no	HQ ≤ 1
Copper	65	18.7	3	YES	HQ > 1
Iron	29,000	20,000	*1*	no	HQ ≤ 1
Lead	240	30.2	8	YES	HQ > 1
Magnesium	1,000	---	NA	YES	No ESV
Manganese	230	460	0.5	no	HQ ≤ 1
Mercury	1.7	0.13	10	YES	HQ > 1
Nickel	29	15.9	2	YES	HQ > 1
Potassium	730	---	NA	YES	No ESV
Selenium	1.1	---	NA	YES	No ESV
Silver	0.38	2	0.2	no	HQ ≤ 1
Sodium	ND	---	NA	YES	No ESV
Vanadium	34	---	NA	YES	No ESV
Zinc	12,000	124	100	YES	HQ > 1
<u>Organics</u>					
2-Butanone	0.02	---	NA	YES	No ESV
Acetone	0.049	0.0099	5	YES	HQ > 1
cis-1,2-Dichloroethene	0.086	---	NA	YES	No ESV
trans-1,2-Dichloroethene	0.02	0.654	0.03	no	HQ ≤ 1
Trichloroethylene	0.0045	0.112	0.04	no	HQ ≤ 1
Vinyl Chloride	0.013	0.202	0.06	no	HQ ≤ 1

Notes:

(yellow box)	HQ > 1	ESV	Ecotoxicity Screening Value.
---	Not available.	HQ	Hazard Quotient.
1	HQ is between 1.0 and 1.5.	mg/kg	Milligrams per kilogram.
COPC	Chemical of Potential Concern.	NA	Not applicable.
		SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-3a.
(b) The sediment ESVs are summarized on Table 2-2.
(c) The HQ is the ratio of the constituent concentration to the appropriate ESV. HQs are rounded to 1 significant digit.
(d) A constituent is considered a COPC if it generates a HQ > 1 or if there is no ESV for that constituent.
(e) This explains why a constituent is (or is not) considered a COPC.

Table 3-2b
Off Site Sediment Direct Contact SLERA Risk Calculations and Identification of COPCs
Eagle Zinc
Hillsboro, Illinois

Constituent	Maximum Concentration in Sediment (a) (mg/kg)	Sediment ESV (b) (mg/kg)	Sediment HQ (c) (unitless)	Sediment COPC? (d) (yes/no)	Rationale (e)
Metals					
Aluminum	19,000	---	NA	YES	No ESV
Antimony	12	12	*1*	no	HQ ≤ 1
Arsenic	25	7.24	3	YES	HQ > 1
Barium	190	---	NA	YES	No ESV
Beryllium	1.1	---	NA	YES	No ESV
Cadmium	96	1	100	YES	HQ > 1
Calcium	23,000	---	NA	YES	No ESV
Chromium	26	52.3	0.5	no	HQ ≤ 1
Cobalt	14	50	0.3	no	HQ ≤ 1
Copper	320	18.7	20	YES	HQ > 1
Iron	45,000	20,000	2	YES	HQ > 1
Lead	2,700	30.2	90	YES	HQ > 1
Magnesium	5,400	---	NA	YES	No ESV
Manganese	750	460	2	YES	HQ > 1
Mercury	1.4	0.13	10	YES	HQ > 1
Nickel	27	15.9	2	YES	HQ > 1
Potassium	1,400	---	NA	YES	No ESV
Selenium	1.4	---	NA	YES	No ESV
Silver	2.4	2	*1*	no	HQ ≤ 1
Vanadium	30	---	NA	YES	No ESV
Zinc	23,000	124	200	YES	HQ > 1

Notes:

(yellow box)	HQ > 1
---	Not available.
1	HQ is between 1.0 and 1.5.
COPC	Chemical of Potential Concern.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/kg	Milligrams per kilogram.
NA	Not applicable.
SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-3b.
(b) The sediment ESVs are summarized on Table 2-2.
(c) The HQ is the ratio of the constituent concentration to the appropriate ESV. HQs are rounded to 1 significant digit.
(d) A constituent is considered a COPC if it generates a HQ > 1 or if there is no ESV for that constituent.
(e) This explains why a constituent is (or is not) considered a COPC.

Table 3-3a
On Site SLERA Water/Dietary Risk Calculations for Piscivores and Identification of COPCs
Eagle Zinc
Hillsboro, Illinois

Constituent	Maximum Concentration in Surface Water (a) (mg/l)	Most Sensitive Piscivore NOAEL-Based ESV (mg/L)	Most Sensitive Piscivore NOAEL-Based HQ (c) (unitless)	Most Sensitive Piscivore NOAEL-Based COPC? (d) (yes/no)	Rationale (e)
Inorganics					
Aluminum	0.037	0.025	*1*	no	HQ ≤ 1
Barium	0.041	---	NA	YES	No ESV
Cadmium	0.23	0.0004367	500	YES	HQ > 1
Calcium	120	---	NA	YES	No ESV
Cobalt	0.0024	---	NA	YES	No ESV
Copper	0.0026	0.294	0.009	no	HQ ≤ 1
Iron	0.17	---	NA	YES	No ESV
Lead	0.0032	0.142	0.02	no	HQ ≤ 1
Magnesium	38	---	NA	YES	No ESV
Manganese	0.3	---	NA	YES	No ESV
Nickel	0.036	2.104	0.02	no	HQ ≤ 1
Potassium	17	---	NA	YES	No ESV
Sodium	57	---	NA	YES	No ESV
Sulfate	450	---	NA	YES	No ESV
Zinc	26	0.085	300	YES	HQ > 1
Organics					
cis-1,2-Dichloroethene	0.0000022	---	NA	YES	No ESV
Trichloroethylene	0.0000063	---	NA	YES	No ESV

Notes:

(highlighted)	HQ > 1
---	Not available.
1	HQ is between 1.0 and 1.5.
COPC	Chemical of Potential Concern.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/l	Milligrams per liter.
NA	Not applicable.
SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-2a.
(b) The surface water ESVs are summarized on Table 2-3.
(c) The HQ is the ratio of the constituent concentration to the appropriate ESV. HQs are rounded to 1 significant digit.
(d) A constituent is considered a COPC if it generates a HQ > 1 or if there is no ESV for that constituent.
(e) This explains why a constituent is (or is not) considered a COPC.

Table 3-3b
Off Site SLERA Water/Dietary Risk Calculations for Piscivores and Identification of COPCs
Eagle Zinc
Hillsboro, Illinois

Constituent	Maximum Concentration in Surface Water (a) (mg/l)	Most Sensitive Piscivore NOAEL-Based ESV (mg/L)	Most Sensitive Piscivore NOAEL-Based HQ (c) (unitless)	Most Sensitive Piscivore NOAEL-Based COPC? (d) (yes/no)	Rationale (e)
Inorganics					
Aluminum	1.4	0.025	60	YES	HQ > 1
Antimony	0.00032	0.22	0.001	no	HQ ≤ 1
Arsenic	0.0022	0.022	0.1	no	HQ ≤ 1
Barium	0.089	---	NA	YES	No ESV
Beryllium	0.00018	0.188	0.001	no	HQ ≤ 1
Cadmium	0.034	0.0004367	80	YES	HQ > 1
Calcium	150	---	NA	YES	No ESV
Chromium	0.0018	4.947	0.0004	no	HQ ≤ 1
Cobalt	0.0016	---	NA	YES	No ESV
Copper	0.0049	0.294	0.02	no	HQ ≤ 1
Iron	3.2	---	NA	YES	No ESV
Lead	0.0052	0.142	0.04	no	HQ ≤ 1
Magnesium	36	---	NA	YES	No ESV
Manganese	0.62	---	NA	YES	No ESV
Mercury	0.00003	0.000001305	20	YES	HQ > 1
Nickel	0.019	2.104	0.009	no	HQ ≤ 1
Potassium	9.2	---	NA	YES	No ESV
Selenium	0.002	0.0004318	5	YES	HQ > 1
Silver	0.00006	---	NA	YES	No ESV
Sodium	60	---	NA	YES	No ESV
Sulfate	330	---	NA	YES	No ESV
Vanadium	0.0051	---	NA	YES	No ESV
Zinc	26	0.085	300	YES	HQ > 1

Notes:

(highlighted)	HQ > 1	HQ	Hazard Quotient.
---	Not available.	mg/l	Milligrams per liter.
COPC	Chemical of Potential Concern.	NA	Not applicable.
ESV	Ecotoxicity Screening Value.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-2b.
(b) The surface water ESVs are summarized on Table 2-3.
(c) The HQ is the ratio of the constituent concentration to the appropriate ESV. HQs are rounded to 1 significant digit.
(d) A constituent is considered a COPC if it generates a HQ > 1 or if there is no ESV for that constituent.
(e) This explains why a constituent is (or is not) considered a COPC.

Table 3-4a

On Site SLERA Food Web Risk Calculations for the Deer Mouse and Identification of COPCs

Eagle Zinc

Hillsboro, Illinois

Constituent (a)	Maximum On Site Concentration (b) In Soil (mg/kg)	Maximum On Site Concentration (b) In Water (mg/L)	90th Percentile Uptake Factors (c) Vegetation (mg COPC/kg dw tissue)/(mg COPC/kg dw soil)	90th Percentile Uptake Factors (c) Invertebrate (mg COPC/kg dw tissue)/(mg COPC/kg dw soil)	Estimated Dietary Tissue Concentrations (d) Vegetation (mg/kg)	Estimated Dietary Tissue Concentrations (d) Invertebrate (mg/kg)	COPC Intake (d) From Soil (mg/kg bw-d)	COPC Intake (d) From Water (mg/kg bw-d)	COPC Intake (d) From Vegetation (mg/kg bw-d)	COPC Intake (d) From Invertebrates (mg/kg bw-d)	Maximum Estimated Dietary Ingestion (d) (mg/kg bw-d)	NOAEL Reference Toxicity Value (e) (mg/kg bw-d)	NOAEL HQ (f) (Unitless)	Food Web COPC? (g) (yes/no)	Rationale (h)
Metals															
Arsenic	13	ND	1.103	0.523	14	6.8	0.0589	NA	2.96	1.83	4.8	0.15	30	YES	HQ > 1
Cadmium	87	0.23	3.25	40.69	280	3,500	0.394	0.0859	59.1	941	1,000	2.12	500	YES	HQ > 1
Chromium	38	ND	—	3.162	NA	120	0.172	NA	NA	32.3	32	6,020	0.005	no	HQ ≤ 1
Copper	35	0.0026	0.625	1.531	22	54	0.159	0.000971	4.65	14.5	19	33.4	0.6	no	HQ ≤ 1
Lead	100	0.0032	0.468	1.522	47	150	0.453	0.00119	9.93	40.3	51	17.6	3	YES	HQ > 1
Mercury	0.27	ND	5	20.625	1.4	5.6	0.00122	NA	0.296	1.51	1.8	2.86	0.6	no	HQ ≤ 1
Nickel	93	0.036	1.411	4.73	130	440	0.422	0.0134	27.5	118	150	87.9	2	YES	HQ > 1
Selenium	1.7	ND	3.012	1.34	5.1	2.3	0.00771	NA	1.08	0.618	1.7	0.44	4	YES	HQ > 1
Silver	0.42	ND	1	1	0.42	0.42	0.0019	NA	0.0887	0.113	0.2	48.8	0.004	no	HQ ≤ 1
Zinc	11,000	26	1.82	12.885	20,000	140,000	49.9	9.71	4,220	37,600	42,000	352	100	YES	HQ > 1

Notes:

(yellow box)	HQ > 1
—	Not available.
COPC	Constituent of Potential Concern.
NOAEL	No observed adverse effects level.
HQ	Hazard quotient.
dw	Dry weight.
mg/L	Milligrams per liter.
mg/kg	Milligrams per kilogram.
mg/kg bw-d	Milligrams per kilogram of body weight per day.
NA	Not applicable.
ND	Not detected.

(a) Only those constituents identified as bioaccumulative COPCs in USEPA 2000, "Bioaccumulation Testing And Interpretation For The Purpose Of Sediment Quality Assessment" are included.
(b) The occurrence of constituents is summarized on Table C-2a and Table C-4 for surface water and soil, respectively.
(c) Refer to Table D-4 for uptake factors and references.
(d) Formulae for estimated tissue concentrations and dietary ingestion scenarios are presented in Table D-2a.
(e) Refer to Table D-1b for reference toxicity values.
(f) The HQ is the ratio of the maximum estimated dietary ingestion of a constituent to the appropriate reference toxicity value. HQs are rounded to 1 significant digit.
(g) A constituent is considered a COPC if it generates a HQ > 1 or if there is no reference toxicity value for that constituent.
(h) This explains why a constituent is (or is not) considered a COPC.

Table 3-4b

On Site SLERA Food Web Risk Calculations for the American Robin and Identification of COPCs

Eagle Zinc

Hillsboro, Illinois

Constituent (a)	Maximum On Site Concentration (b)		90th Percentile Uptake Factors (c)		Estimated Dietary Tissue Concentrations (d)		COPC Intake (d)				Maximum Estimated Dietary Ingestion (d)	NOAEL Reference Toxicity Value (e)	NOAEL HQ (f)	Food Web COPC? (g)	Rationale (h)
	In Soil	In Water	Vegetation	Invertebrate	Vegetation	Invertebrate	From Soil	From Water	From Vegetation	From Invertebrates					
	(mg/kg)	(mg/L)	(mg COPC/kg dw tissue)/(mg COPC/kg dw soil)		(mg/kg)		(mg/kg bw-d)				(mg/kg bw-d)		Unitless	(yes/no)	
Metals															
Arsenic	13	ND	1.103	0.523	14	6.8	0.321	NA	0.255	1.64	2.2	2.46	0.9	no	HQ ≤ 1
Cadmium	87	0.23	3.25	40.69	280	3,500	2.15	0.0388	5.09	845	850	1.45	600	YES	HQ > 1
Chromium	38	ND	---	3.162	NA	120	0.938	NA	NA	29	30	1	30	YES	HQ > 1
Copper	35	0.0026	0.625	1.531	22	54	0.864	0.000439	0.4	13	14	47	0.3	no	HQ ≤ 1
Lead	100	0.0032	0.468	1.522	47	150	2.47	0.00054	0.855	36.2	40	3.85	10	YES	HQ > 1
Mercury	0.27	ND	5	20.625	1.4	5.6	0.00666	NA	0.0255	1.35	1.4	0.45	3	YES	HQ > 1
Nickel	93	0.036	1.411	4.73	130	440	2.29	0.00608	2.36	106	110	77.4	*1*	no	HQ ≤ 1
Selenium	1.7	ND	3.012	1.34	5.1	2.3	0.0419	NA	0.0927	0.556	0.69	0.5	*1*	no	HQ ≤ 1
Silver	0.42	ND	1	1	0.42	0.42	0.0104	NA	0.00764	0.101	0.12	17	0.007	no	HQ ≤ 1
Zinc	11,000	26	1.82	12.885	20,000	140,000	271	4.39	364	33,800	34,000	14.5	2,000	YES	HQ > 1

Notes:

(yellow box)	HQ > 1	dw	Dry weight.
---	Not available.	mg/L	Milligrams per liter.
1	HQ is between 1.0 and 1.5.	mg/kg	Milligrams per kilogram.
COPC	Constituent of Potential Concern.	mg/kg bw-d	Milligrams per kilogram of body weight per day.
NOAEL	No observed adverse effects level.	NA	Not applicable.
HQ	Hazard quotient.	ND	Not detected.

(a) Only those constituents identified as bioaccumulative COPCs in USEPA 2000, "Bioaccumulation Testing And Interpretation For The Purpose Of Sediment Quality Assessment" are included.

(b) The occurrence of constituents is summarized on Table C-2a and Table C-4 for surface water and soil, respectively.

(c) Refer to Table D-4 for uptake factors and references.

(d) Formulae for estimated tissue concentrations and dietary ingestion scenarios are presented in Table D-2b.

(e) Refer to Table D-1c for reference toxicity values.

(f) The HQ is the ratio of the maximum estimated dietary ingestion of a constituent to the appropriate reference toxicity value. HQs are rounded to 1 significant digit.

(g) A constituent is considered a COPC if it generates a HQ > 1 or if there is no reference toxicity value for that constituent.

(h) This explains why a constituent is (or is not) considered a COPC.

Table 3-4c

On Site SLERA Food Web Risk Calculations for the Red-Tailed Hawk and Identification of COPCs

Eagle Zinc

Hillsboro, Illinois

Constituent (a)	Maximum On Site Concentration (b) (mg/kg)	Maximum On Site Concentration (b) (mg/L)	90th Percentile Uptake Factors for the Most Sensitive Mammal (c) (mg COPC/kg dw tissue)/ (mg COPC/kg dw soil)	Estimated Dietary Tissue Concentrations (d) Most Sensitive Mammal (mg/kg)	COPC Intake (d) From Water (mg/kg bw-d)	COPC Intake (d) From Mammals (mg/kg bw-d)	Maximum Estimated Dietary Ingestion (d) (mg/kg bw-d)	NOAEL Reference Toxicity Value (e) (mg/kg bw-d)	NOAEL HQ (f) (unitless)	Food Web COPC? (g) (yes/no)	Rationale (h)
Metals											
Arsenic	13	ND	0.016	0.21	NA	0.016	0.016	2.46	0.007	no	HQ ≤ 1
Cadmium	87	0.23	7.017	610	0.0185	46.5	47	1.45	30	YES	HQ > 1
Chromium	38	ND	0.349	13	NA	0.992	0.99	1	***1***	no	HQ ≤ 1
Copper	35	0.0026	1.29	45	0.000209	3.43	3.4	47	0.07	no	HQ ≤ 1
Lead	100	0.0032	0.339	34	0.000257	2.59	2.6	3.85	0.7	no	HQ ≤ 1
Mercury	0.27	ND	1.046	0.28	NA	0.0214	0.021	0.45	0.05	no	HQ ≤ 1
Nickel	93	0.036	0.898	84	0.0029	6.41	6.4	77.4	0.08	no	HQ ≤ 1
Selenium	1.7	ND	1.263	2.1	NA	0.16	0.16	0.5	0.3	no	HQ ≤ 1
Silver	0.42	ND	1	0.42	NA	0.032	0.032	17	0.002	no	HQ ≤ 1
Zinc	11,000	26	2.90106	32,000	2.09	2,440	2,400	14.5	200	YES	HQ > 1

Notes:

(yellow shading)	HQ > 1		
1	HQ is between 1.0 and 1.5.	mg/L	Milligrams per liter.
COPC	Constituent of Potential Concern.	mg/kg	Milligrams per kilogram.
NOAEL	No observed adverse effects level.	mg/kg bw-d	Milligrams per kilogram of body weight per day.
HQ	Hazard quotient.	NA	Not available or not applicable.
dw	Dry weight.	ND	Not detected.

(a) Only those constituents identified as bioaccumulative COPCs in USEPA 2000, "Bioaccumulation Testing And Interpretation For The Purpose Of Sediment Quality Assessment" are included.
(b) The occurrence of constituents is summarized on Table C-2a and Table C-4 for surface water and soil, respectively.
(c) Refer to Table D-4 for uptake factors and references.
(d) Formulae for estimated tissue concentrations and dietary ingestion scenarios are presented in Table D-2c.
(e) Refer to Table D-1c for reference toxicity values.
(f) The HQ is the ratio of the maximum estimated dietary ingestion of a constituent to the appropriate reference toxicity value. HQs are rounded to 1 significant digit.
(g) A constituent is considered a COPC if it generates a HQ > 1 or if there is no reference toxicity value for that constituent.
(h) This explains why a constituent is (or is not) considered a COPC.

Table 3-5a
Effects of Uncertainty In Ecological Risk Assessments
Eagle Zinc
Hillsboro, Illinois

Source of Uncertainty	SLERA Management Approach	Effect on SLERA Results
	Analytical Sampling and Data Analysis	
Limited number of samples - biased sampling	Typically, only a limited number of samples are used in ERAs, and very often they are collected in a biased manner (i.e., targeting "hot spots"). This type of sampling often lacks statistical power and does not likely represent the concentrations in the environment in which wildlife exposure occurs.	Overestimate of exposure and risk
Use of maximum concentrations	The use of the maximum detected concentrations overestimates exposure and risk.	Overestimate of exposure and risk
Non detections, with detection limits that exceed ecotoxicity screening values	There are occasions when analytical detection limits exceed ecotoxicity screening values (ESVs). This can be due to instrument and method limitations and/or due to interference from unrelated chemicals (e.g., dilutions required to bring some other chemical within a calibration range). A comparison of maximum detection limits to ESVs for the Eagle Zinc Site is provided in Tables 3-5b and 3-5c for surface water and sediment, respectively.	Underestimate of exposure and risk
	Selection of Constituents of Potential Concern (COPCs)	
Background concentrations	Chemicals may be identified as COPCs despite the fact that the detected concentrations are less than background concentrations. This occurs because the ERA Process does not permit use of background until Step 3a of the BERA (USEPA 2001b).	Overestimate of exposure and risk
	Toxicology and Ecotoxicity Screening Values	
Toxicity data	Toxicity data are only available for a limited number of species (most of them laboratory test species) under a strictly defined set of test conditions that deviate from natural conditions (Sample et al. 1996; Suter 1996).	Effect on risk estimate unknown
Laboratory toxicity testing	Simplistic extrapolations from laboratory species to wildlife species and testing conditions to field conditions are not likely accurate, and are rarely, if ever, validated against natural conditions (Power 1996; Tannenbaum 2003).	Overestimate of exposure and risk
Adaptation and tolerance	Consideration of bioavailability (and, thereby, diminished toxicity) tolerance and adaptation are intentionally not considered directly in a SLERA. Further, there is little consistency and no quantitative methodology for the consideration of the bioavailability (and, thereby, diminished toxicity) even though this process is well documented (e.g. Alexander 2000). Similarly, tolerance and adaptation is well documented (Millward and Klerks 2002; Grant 2002).	Overestimate of exposure and risk
	Hazard Quotients (HQs)	
HQs based on maximum concentrations	The SLERA HQ is based on the maximum detected concentrations and the most conservative ecotoxicity screening value available (USEPA 1997).	Overestimate of exposure and risk
Elevated HQs for background concentrations	HQs may exceed a value of 1 for background concentrations of naturally occurring metals (Tannenbaum 2003). This is due to many of the toxicology and ESV uncertainties already discussed. Also, background HQs greater than 1 indicate that indigenous wildlife would have adapted to these COPCs.	Overestimate of exposure and risk
Interpretation of HQs	An HQ less than or equal to a value of 1 indicates that adverse impacts to wildlife are considered unlikely (USEPA 2001b). However, there is no clear guidance for interpreting the HQs that exceed a value of 1, except that this point of departure may indicate that adverse effects of some kind may have occurred or may occur in the future.	Overestimate of exposure and risk
HQs for individual used to evaluate risks to populations	Although intentionally conservative in a SLERA, HQs are based on the types of impacts that could occur to individuals (i.e., those individuals exposed to maximum concentrations), and they completely fail to address ecological exposure and risk at spatial scale of populations (Tannenbaum 2003; Durda and Preziosi 1999).	Overestimate of exposure and risk
HQs with unrealistic magnitudes	HQs are seen at magnitudes that suggest acute toxicity. Often, conditions at a site document that this is not the case.	Overestimate of exposure and risk

Notes:

BERA Baseline ecological risk assessment.
COPC Constituent of potential concern.
ERA Ecological risk assessment.
ESV Ecotoxicity Screening Value.
HQ Hazard quotient.
SLERA Screening level ecological risk assessment.

Table 3-5b
Uncertainties in Comparisons of Surface Water Detection Limits to Ecological Screening Values
Eagle Zinc
Hillsboro, Illinois

Constituent	Range of Detection Limits in Surface Water (a) (mg/l)	Background (mg/l) Eastern Drainage	Western Drainage	Surface Water ESVs (b) (mg/l) Direct Contact	Most Sensitive Piscivore NOAEL-Based	MINIMUM DETECTION LIMIT (unitless) Direct Contact HQ (d)	Piscivore Water/Diet HQ (d)	MAXIMUM DETECTION LIMIT (unitless) Direct Contact HQ (d)	Piscivore Water/Diet HQ (d)	EASTERN BACKGROUND (unitless) Direct Contact HQ (d)	Piscivore Water/Diet HQ (d)	WESTERN BACKGROUND (unitless) Direct Contact HQ (d)	Piscivore Water/Diet HQ (d)
<u>Inorganics</u>													
Aluminum	0.027 – 0.076	0.17	1.1	0.087	0.025	0.3	***1***	0.9	3	2	7	***1***	3
Antimony	0.0025 – 0.0025	ND	0.0003	0.03	0.22	0.08	0.01	0.08	0.01	NA	NA	***1***	0.1
Arsenic	0.0081 – 0.0081	ND	0.0023	0.19	0.022	0.04	0.4	0.04	0.4	NA	NA	***1***	9
Barium		0.14	0.087	0.004	---	NA	NA	NA	NA	40	NA	***1***	NA
Beryllium	0.0001 – 0.00061	ND	0.00021	0.00066	0.188	0.2	0.0005	0.9	0.003	NA	NA	***1***	0.004
Cadmium	0.00053	ND	0.0058	0.00261	0.0004367	NA	NA	0.2	***1***	NA	NA	***1***	6
Calcium		88	100	---	---	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	0.00093 – 0.00093	0.001	0.0016	0.011	4.947	0.08	0.0002	0.08	0.0002	0.09	0.0002	***1***	0.002
Cobalt	0.0009 – 0.0009	ND	0.0044	0.023	---	0.04	NA	0.04	NA	NA	NA	***1***	NA
Copper		0.0044	0.0059	0.0334	0.294	NA	NA	NA	NA	0.1	0.01	***1***	0.1
Iron		0.28	15	1	---	NA	NA	NA	NA	0.3	NA	***1***	NA
Lead	0.0013 – 0.0013	ND	0.0038	0.0607	0.142	0.02	0.009	0.02	0.009	NA	NA	***1***	0.4
Magnesium		12	26	---	---	NA	NA	NA	NA	NA	NA	NA	NA
Manganese		0.11	0.49	0.12	---	NA	NA	NA	NA	0.9	NA	***1***	NA
Mercury	0.00002 – 0.0002	ND	0.000034	0.0011	0.000001305	0.02	20	0.2	200	NA	NA	***1***	800
Nickel		0.0025	0.013	0.0145	2.104	NA	NA	NA	NA	0.2	0.001	***1***	0.007
Potassium		5.7	5.4	---	---	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.0048 – 0.0048	ND	0.0013	0.005	0.0004318	***1***	10	***1***	10	NA	NA	***1***	10
Silver	0.000049 – 0.0011	ND	0.00008	0.00036	---	0.1	NA	3	NA	NA	NA	***1***	NA
Sodium		29	62	---	---	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate		21	95	---	---	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	0.00084 – 0.00084	0.0015	0.0047	0.02	---	0.04	NA	0.04	NA	0.08	NA	***1***	NA
Zinc		1.4	3.7	0.062	0.085	NA	NA	NA	NA	20	20	***1***	0.7
<u>Organics</u>													
cis-1,2-Dichloroethene	0.00000081 – 0.00000081	ND	ND	0.59	---	0.000001	NA	0.000001	NA	NA	NA	***1***	NA
Trichloroethylene	0.00000039 – 0.00000039	ND	ND	0.047	---	0.000008	NA	0.000008	NA	NA	NA	***1***	NA

Notes:

(yellow box)	HQ > 1	HQ	Hazard Quotient.
---	Not available.	mg/l	Milligrams per liter.
COPC	Chemical of Potential Concern.	NA	Not applicable.
ESV	Ecotoxicity Screening Value.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-9a.
(b) The surface water ESVs are summarized on Tables 2-1a and 2-3.
(c) The HQ is the ratio of the detection limit to the appropriate ESV. HQs are rounded to 1 significant digit.

Table 3-5c
Uncertainties in Comparisons of Sediment Detection Limits to Ecological Screening Values
Eagle Zinc
Hillsboro, Illinois

Constituent	Range of Detection Limits in Sediment (a) (mg/l)	Direct Contact Sediment ESVs (b) (mg/l)	Direct Contact HQ (c) MINIMUM DETECTION LIMIT (unitless)	MAXIMUM DETECTION LIMIT
Inorganics				
Aluminum		---	NA	NA
Antimony	0.45	12	NA	0.04
Arsenic		7.24	NA	NA
Barium		---	NA	NA
Beryllium		---	NA	NA
Cadmium		1	NA	NA
Calcium		---	NA	NA
Chromium		52.3	NA	NA
Cobalt		50	NA	NA
Copper		18.7	NA	NA
Iron		20,000	NA	NA
Lead		30.2	NA	NA
Magnesium		---	NA	NA
Manganese		460	NA	NA
Mercury	0.0046	0.13	NA	0.04
Nickel		15.9	NA	NA
Potassium		---	NA	NA
Selenium	0.44 – 0.73	---	NA	NA
Silver	0.066 – 0.1	2	0.03	0.05
Sodium	21 – 92	---	NA	NA
Vanadium		---	NA	NA
Zinc		124	NA	NA
Organics				
2-Butanone		---	NA	NA
Acetone		0.0099	NA	NA
cis-1,2-Dichloroethene	0.0012 – 0.0017	---	NA	NA
trans-1,2-Dichloroethene	0.001 – 0.0014	0.654	0.002	0.002
Trichloroethylene	0.0012 – 0.0017	0.112	0.01	0.02
Vinyl Chloride	0.0011 – 0.0015	0.202	0.005	0.007

Notes:

ESV Ecotoxicity Screening Value.
HQ Hazard Quotient.
mg/kg Milligrams per kilogram.
NA Not available or not applicable.

(a) Occurrence of constituents summarized on Table C-9b.
(b) The sediment ESVs are summarized on Table 2-2.
(c) The HQ is the ratio of the detection limit to the appropriate ESV. HQs are rounded to 1 significant digit.

Table 4-1a
Refinement of Direct Contact Surface Water COPCs (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Surface Water (a) (mg/l)	EPC in Surface Water (a) (mg/l)		Eastern Drainage Background Concentration in Surface Water (b) (mg/l)	EPC > Bkg (or Bkg ND) (yes/no)	SLERA ESV (c) (mg/l)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Aluminum	0.13	0.13	m	0.17	no	NA		no	EPC < Bkg
Barium	0.071	0.071	m	0.14	no	NA		no	EPC < Bkg
Cadmium	0.0071	0.0071	m	ND	YES	0.00261	YES	YES	EPC > Bkg; EPC > ESV
Calcium	80	80	m	88	NA			no	Essential Nutrient
Iron	0.28	0.28	m	0.28	no	NA		no	EPC < Bkg
Magnesium	27	27	m	12	NA			no	Essential Nutrient
Manganese	0.38	0.38	m	0.11	YES	0.12	YES	YES	EPC > Bkg; EPC > ESV
Potassium	5.2	5.2	m	5.7	NA			no	Essential Nutrient
Sodium	41	41	m	29	NA			no	Essential Nutrient
Sulfate	160	160	m	21	YES	---	YES	YES	EPC > Bkg; No ESV
Zinc	11	11	m	1.4	YES	0.062	YES	YES	EPC > Bkg; EPC > ESV

Notes:

---	Not available.
BERA	Baseline Ecological Risk Assessment.
Bkg	Background.
COPC	Chemical of Potential Concern.
EPC	Exposure Point Concentration.
ESV	Ecotoxicity Screening Value.
m	The EPC is the maximum concentration.
mg/l	Milligrams per liter.
NA	Not applicable.
ND	Not detected.
SLERA	Screening Level Ecological Risk Assessment.

(a) A summary of the surface water data is presented on Table C-6a. Only those constituents identified in Step 2 of the SLERA are carried forward (Table 3-1b).
(b) Background concentrations are summarized on Table C-8a.
(c) The surface water ESVs are summarized on Table 2-1a.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-1b
Refinement of Direct Contact Surface Water COPCs (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Surface Water (a) (mg/l)	EPC in Surface Water (a) (mg/l)		Western Drainage Background Concentration in Surface Water (b) (mg/l)	EPC > Bkg (or Bkg ND) (yes/no)	SLERA ESV (c) (mg/l)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Barium	0.041	0.041	m	0.087	no	NA		no	EPC < Bkg
Cadmium	0.23	0.23	m	0.0058	YES	0.00261	YES	YES	EPC > Bkg; EPC > ESV
Calcium	120	120	m	100	NA			no	Essential Nutrient
Magnesium	38	38	m	26	NA			no	Essential Nutrient
Manganese	0.3	0.3	m	0.49	no	NA		no	EPC < Bkg
Nickel	0.036	0.036	m	0.013	YES	0.0145	YES	YES	EPC > Bkg; EPC > ESV
Potassium	17	17	m	5.4	NA			no	Essential Nutrient
Sodium	57	57	m	62	NA			no	Essential Nutrient
Sulfate	450	450	m	95	YES	---	YES	YES	EPC > Bkg; No ESV
Zinc	26	26	m	3.7	YES	0.062	YES	YES	EPC > Bkg; EPC > ESV

Notes:

--- Not available.
BERA Baseline Ecological Risk Assessment.
Bkg Background.
COPC Chemical of Potential Concern.
EPC Exposure Point Concentration.
ESV Ecotoxicity Screening Value.
m The EPC is the maximum concentration.
mg/l Milligrams per liter.
NA Not applicable.
ND Not detected.
SLERA Screening Level Ecological Risk Assessment.

(a) A summary of the surface water data is presented on Table C-6a. Only those constituents identified in Step 2 of the SLERA are carried forward (Table 3-1a).
(b) Background concentrations are summarized on Table C-8a.
(c) The surface water ESVs are summarized on Table 2-1a.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-1c
Refinement of Direct Contact Surface Water COPCs (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Surface Water (a) (mg/l)	EPC in Surface Water (a) (mg/l)		Western Drainage Background Concentration in Surface Water (b) (mg/l)	EPC > Bkg (or Bkg ND) (yes/no)	SLERA ESV (c) (mg/l)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Aluminum	1.4	1.4	m	1.1	YES	0.087	YES	YES	EPC > Bkg; EPC > ESV
Barium	0.089	0.074	u	0.087	no	NA		no	EPC < Bkg
Cadmium	0.034	0.034	m	0.0058	YES	0.00261	YES	YES	EPC > Bkg; EPC > ESV
Calcium	150	150	m	100	NA			no	Essential Nutrient
Iron	3.2	2.8	u	15	no	NA		no	EPC < Bkg
Magnesium	36	35	u	26	NA			no	Essential Nutrient
Manganese	0.62	0.62	m	0.49	YES	0.12	YES	YES	EPC > Bkg; EPC > ESV
Potassium	9.2	8.5	u	5.4	NA			no	Essential Nutrient
Sodium	60	60	u	62	NA			no	Essential Nutrient
Sulfate	330	330	m	95	YES	---	YES	YES	EPC > Bkg; No ESV
Zinc	26	26	m	3.7	YES	0.062	YES	YES	EPC > Bkg; EPC > ESV

Notes:

--- Not available.
BERA Baseline Ecological Risk Assessment.
Bkg Background.
COPC Chemical of Potential Concern.
EPC Exposure Point Concentration.
ESV Ecotoxicity Screening Value.
m The EPC is the maximum concentration.
mg/l Milligrams per liter.
NA Not applicable.
ND Not detected.
SLERA Screening Level Ecological Risk Assessment.

(a) A summary of the surface water data is presented on Table C-6a. Only those constituents identified in Step 2 of the SLERA are carried forward (Table 3-1b).
(b) Background concentrations are summarized on Table C-8a.
(c) The surface water ESVs are summarized on Table 2-1a.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-2a
Refinement of Direct Contact Sediment COPCs (Eastern Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Detected Concentration in Sediment (a) (mg/kg)	Eastern Drainage Background Concentration in Sediment (b) (mg/kg)	Detection > Bkg (or Bkg ND) (yes/no)	SLERA ESV (c) (mg/kg)	Detection > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics							
Aluminum	6,100	6,000	YES	---	YES	YES	Concentration > Bkg; No ESV
Barium	82	68	YES	---	YES	YES	Concentration > Bkg; No ESV
Beryllium	0.36	0.42	no	NA		no	Concentration < Bkg
Cadmium	2.4	0.91	YES	1	YES	YES	Concentration > Bkg; Concentration > ESV
Calcium	1,300	1,900	NA			no	Essential Nutrient
Copper	8.9	7.5	YES	18.7	no	no	Concentration < ESV
Lead	25	14	YES	30.2	no	no	Concentration < ESV
Magnesium	760	740	NA			no	Essential Nutrient
Mercury	0.019	0.013	YES	0.13	no	no	Concentration < ESV
Nickel	4.6	5	no	NA		no	Concentration < Bkg
Potassium	660	720	NA			no	Essential Nutrient
Vanadium	13	14	no	NA		no	Concentration < Bkg
Zinc	830	460	YES	124	YES	YES	Concentration > Bkg; Concentration > ESV

Notes:

--- Not available.
BERA Baseline Ecological Risk Assessment.
Bkg Background.
COPC Chemical of Potential Concern.
EPC Exposure Point Concentration.
ESV Ecotoxicity Screening Value.
mg/kg Milligrams per kilogram.
NA Not applicable.
ND Not detected.
SLERA Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-7a. Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Table 3-2a).
(b) Background concentrations are summarized on Table C-8b.
(c) The sediment ESVs are summarized on Table 2-2.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-2b
Refinement of Direct Contact Sediment COPCs (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Sediment (a) (mg/kg)	EPC in Sediment (a) (mg/kg)		Eastern Drainage Background EPC in Sediment (b) (mg/kg)	EPC > Bkg (or Bkg ND) (yes/no)	SLERA ESV (c) (mg/kg)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Aluminum	9,600	9,600	m	6,000	YES	---	YES	YES	EPC > Bkg; No ESV
Arsenic	7.2	7.2	m	2.1	YES	7.24	no	no	EPC < ESV
Barium	71	71	m	68	YES	---	YES	YES	EPC > Bkg; No ESV
Beryllium	0.75	0.75	m	0.42	YES	---	YES	YES	EPC > Bkg; No ESV
Cadmium	13	13	m	0.91	YES	1	YES	YES	EPC > Bkg; EPC > ESV
Calcium	23,000	23,000	m	1,900	NA			no	Essential Nutrient
Copper	53	53	m	7.5	YES	18.7	YES	YES	EPC > Bkg; EPC > ESV
Iron	19,000	19,000	m	5,100	YES	20,000	no	no	EPC < ESV
Lead	87	87	m	14	YES	30.2	YES	YES	EPC > Bkg; EPC > ESV
Magnesium	5,400	5,400	m	740	NA			no	Essential Nutrient
Manganese	750	750	m	130	YES	460	YES	YES	EPC > Bkg; EPC > ESV
Mercury	0.15	0.15	m	0.013	YES	0.13	YES	YES	EPC > Bkg; EPC > ESV
Nickel	17	17	m	5	YES	15.9	YES	YES	EPC > Bkg; EPC > ESV
Potassium	860	860	m	720	NA			no	Essential Nutrient
Vanadium	27	27	m	14	YES	---	YES	YES	EPC > Bkg; No ESV
Zinc	11,000	11,000	m	460	YES	124	YES	YES	EPC > Bkg; EPC > ESV

Notes:

---	Not available.	ESV	Ecotoxicity Screening Value.
BERA	Baseline Ecological Risk Assessment.	mg/kg	Milligrams per kilogram.
Bkg	Background.	NA	Not applicable.
COPC	Chemical of Potential Concern.	ND	Not detected.
EPC	Exposure Point Concentration.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-7b. Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Table 3-2b).
(b) Background concentrations are summarized on Table C-8b.
(c) The sediment ESVs are summarized on Table 2-2.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-2c
Refinement of Direct Contact Sediment COPCs (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Sediment (a) (mg/kg)	Western Drainage Background Concentration in Sediment (b) (mg/kg)	Max > Bkg OR Bkg ND (yes/no)	SLERA ESV (c) (mg/kg)	Max > ESV OR No ESV (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics							
Aluminum	*7,600*	*12,000*	*no*	NA		*no*	*Max < Bkg*
Barium	76	86	no	NA		no	Max < Bkg
Beryllium	0.67	0.92	no	NA		no	Max < Bkg
Cadmium	550	1.4	YES	1	YES	YES	Max > Bkg; Max > ESV
Calcium	2,400	18,000	NA			no	Essential Nutrient
Copper	65	30	YES	18.7	YES	YES	Max > Bkg; Max > ESV
Lead	240	46	YES	30.2	YES	YES	Max > Bkg; Max > ESV
Magnesium	1,000	2,100	NA			no	Essential Nutrient
Mercury	1.7	0.057	YES	0.13	YES	YES	Max > Bkg; Max > ESV
Nickel	29	16	YES	15.9	YES	YES	Max > Bkg; Max > ESV
Potassium	730	1,200	NA			no	Essential Nutrient
Selenium	1.1	ND	YES	---	YES	YES	Max > Bkg; No ESV
Sodium	ND	150				no	Not detected
Vanadium	34	26	YES	---	YES	YES	Max > Bkg; No ESV
Zinc	12,000	920	YES	124	YES	YES	Max > Bkg; Max > ESV
Organics							
2-Butanone	0.02	ND	YES	---	YES	YES	Max > Bkg; No ESV
Acetone	0.049	ND	YES	0.0099	YES	YES	Max > Bkg; Max > ESV
cis-1,2-Dichloroethene	0.086	ND	YES	---	YES	YES	Max > Bkg; No ESV

Notes:

---	Not available.	ESV	Ecotoxicity Screening Value.
BERA	Baseline Ecological Risk Assessment.	mg/kg	Milligrams per kilogram.
Bkg	Background.	NA	Not applicable.
COPC	Chemical of Potential Concern.	ND	Not detected.
EPC	Exposure Point Concentration.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-7c. Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Table 3-2a).

(b) Background concentrations are summarized on Table C-8b.

(c) The sediment ESVs are summarized on Table 2-2.

(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.

(e) Why a constituent is (or is not) considered a COPC.

Table 4-2d
Refinement of Direct Contact Sediment COPCs (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Sediment (a) (mg/kg)	EPC in Sediment (a) (mg/kg)		Western Drainage Background Concentration in Sediment (b) (mg/kg)	EPC > Bkg (or Bkg ND) (yes/no)	SLERA ESV (c) (mg/kg)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Aluminum	19,000	17,000	u	12,000	YES	---	YES	YES	EPC > Bkg; No ESV
Arsenic	25	21	u	15	YES	7.24	YES	YES	EPC > Bkg; EPC > ESV
Barium	190	150	u	86	YES	---	YES	YES	EPC > Bkg; No ESV
Beryllium	1.1	0.87	u	0.92	no	NA		no	EPC < Bkg
Cadmium	96	96	m	1.4	YES	1	YES	YES	EPC > Bkg; EPC > ESV
Calcium	14,000	14,000	m	18,000	NA			no	Essential Nutrient
Copper	320	320	m	30	YES	18.7	YES	YES	EPC > Bkg; EPC > ESV
Iron	45,000	40,000	u	16,000	YES	20,000	YES	YES	EPC > Bkg; EPC > ESV
Lead	2,700	2,700	m	46	YES	30.2	YES	YES	EPC > Bkg; EPC > ESV
Magnesium	2,700	2,700	u	2,100	NA			no	Essential Nutrient
Manganese	420	420	m	480	no	NA		no	EPC < Bkg
Mercury	1.4	1.4	m	0.057	YES	0.13	YES	YES	EPC > Bkg; EPC > ESV
Nickel	27	27	m	16	YES	15.9	YES	YES	EPC > Bkg; EPC > ESV
Potassium	1,400	1,000	u	1,200	NA			no	Essential Nutrient
Selenium	1.4	0.85	u	ND	YES	---	YES	YES	EPC > Bkg; No ESV
Vanadium	30	25	u	26	no	NA		no	EPC < Bkg
Zinc	23,000	23,000	m	920	YES	124	YES	YES	EPC > Bkg; EPC > ESV

Notes:

---	Not available.
BERA	Baseline Ecological Risk Assessment.
Bkg	Background.
COPC	Chemical of Potential Concern.
EPC	Exposure Point Concentration.
ESV	Ecotoxicity Screening Value.
mg/kg	Milligrams per kilogram.
NA	Not applicable.
ND	Not detected.
SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-7d. Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Table 3-2b).
(b) Background concentrations are summarized on Table C-8b.
(c) The sediment ESVs are summarized on Table 2-2.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-3a
Refinement of Surface Water Risk Calculations for Aquatic Wildlife (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		SLERA ESV (b) (mg/L)	Acute ESV (c) (mg/L)	Background HQs (d) SLERA HQ (unitless)	Background HQs (d) Acute HQ (unitless)	SW-ED-13 SLERA HQ (unitless)	SW-ED-13 Acute HQ (unitless)	SW-ED-16 SLERA HQ (unitless)	SW-ED-16 Acute HQ (unitless)
Inorganics									
	Cadmium	0.00261	0.0361	Bkg ND	Bkg ND	3	0.2	ND	ND
	Manganese	0.12	---	0.9	No ESV	3	>Bkg/No ESV	<Bkg	<Bkg
	Sulfate	---	---	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Zinc	0.062	0.302	20	5	200	40	<Bkg	<Bkg

Notes:

(yellow shading)	HQ > 1
---	Not available.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-1a).

(b) The surface water ESVs are summarized on Table 2-1a.

(c) Values are selected based on the following hierarchy: the State of Illinois acute criteria, NRWQC acute criteria, Region IV acute criteria.

(d) Analytical data for background locations are in Table B-4.

Table 4-3b
Refinement of Surface Water Risk Calculations for Aquatic Wildlife (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		SLERA ESV (b) (mg/L)	Acute ESV (c) (mg/L)	Background HQs (d) SLERA HQ (unitless)	Background HQs (d) Acute HQ (unitless)	SW-WD-9 SLERA HQ (unitless)	SW-WD-9 Acute HQ (unitless)	SW-WD-PN SLERA HQ (unitless)	SW-WD-PN Acute HQ (unitless)	SW-WD-PS SLERA HQ (unitless)	SW-WD-PS Acute HQ (unitless)
Inorganics											
	Cadmium	0.00261	0.0361	2	0.2	90	6	30	2	30	2
	Nickel	0.0145	0.0851	0.9	0.2	2	0.4	2	0.3	2	0.3
	Sulfate	---	---	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Zinc	0.062	0.302	60	10	400	90	300	50	200	50

Notes:

(yellow shading)	HQ > 1
---	Not available.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-1b).

(b) The surface water ESVs are summarized on Table 2-1a.

(c) Values are selected based on the following hierarchy: the State of Illinois acute criteria, NRWQC acute criteria, Region IV acute criteria.

(d) Analytical data for background locations are in Table B-4.

Table 4-3c
Refinement of Surface Water Risk Calculations for Aquatic Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	SLERA ESV (b) (mg/L)	Acute ESV (c) (mg/L)	Background HQs (d) SLERA HQ (unitless)	Background HQs (d) Acute HQ (unitless)	SW-WD-6a SLERA HQ (unitless)	SW-WD-6a Acute HQ (unitless)	SW-WD-6b SLERA HQ (unitless)	SW-WD-6b Acute HQ (unitless)	SW-WD-6bd SLERA HQ (unitless)	SW-WD-6bd Acute HQ (unitless)	SW-WD-12 SLERA HQ (unitless)	SW-WD-12 Acute HQ (unitless)
Inorganics												
Aluminum	0.087	0.75	10	*1*	<Bkg	<Bkg	ND	ND	ND	ND	20	2
Cadmium	0.00261	0.0361	2	0.2	7	0.5	2	0.2	3	0.2	<Bkg	<Bkg
Manganese	0.12	---	4	No ESV	5	>Bkg/No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Sulfate	---	---	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	ND	ND	ND	ND	ND	ND
Zinc	0.062	0.302	60	10	200	50	60	10	<Bkg	<Bkg	<Bkg	<Bkg

Notes:

(highlighted)	HQ > 1
---	Not available.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-1c).

(b) The surface water ESVs are summarized on Table 2-1a.

(c) Values are selected based on the following hierarchy: the State of Illinois acute criteria, NRWQC acute criteria, Region IV acute criteria.

(d) Analytical data for background locations are in Table B-4.

Table 4-3c
Refinement of Surface Water Risk Calculations for Aquatic Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		SLERA ESV (b) (mg/L)	Acute ESV (c) (mg/L)	Background HQs (d) (unitless)		SW-WD-7 (unitless)		SW-WD-7D (unitless)		SW-WD-8 (unitless)	
				SLERA HQ	Acute HQ	SLERA HQ	Acute HQ	SLERA HQ	Acute HQ	SLERA HQ	Acute HQ
Inorganics											
	Aluminum	0.75	0.087	10	*1*	ND	ND	ND	ND	ND	ND
	Cadmium	0.0361	0.00261	2	0.2	10	0.9	10	0.9	<Bkg	<Bkg
	Manganese	---	0.12	4	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
	Sulfate	---	---	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Zinc	0.302	0.062	60	10	400	80	400	90	<Bkg	<Bkg

Notes:

(highlighted)	HQ > 1
---	Not available.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-1c).

(b) The surface water ESVs are summarized on Table 2-1a.

(c) Values are selected based on the following hierarchy: the State of Illinois acute criteria, NRWQC acute criteria, Region IV acute criteria.

(d) Analytical data for background locations are in Table B-4.

Table 4-4a
Refinement of Sediment Risk Calculations for Aquatic Wildlife (Eastern Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		SLERA ESV (b) (mg/kg)	NOAA PEL (b) (mg/kg)	USGS SEL (b) (mg/kg)	Background HQs (c) SLERA HQ (unitless)	Background HQs (c) PEL HQ (unitless)	Background HQs (c) SEL HQ (unitless)	SD-ED-12 SLERA HQ (unitless)	SD-ED-12 PEL HQ (unitless)	SD-ED-12 SEL HQ (unitless)
Inorganics										
	Aluminum	---	---	---	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Barium	---	---	---	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Cadmium	1	3.53	10	0.9	0.3	0.09	2	0.7	0.2
	Zinc	124	315	820	4	*1*	0.6	7	3	*1*

Notes:

[yellow shading]	HQ > 1
---	Not available.
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/kg	Milligrams per kilogram.
ND	Not detected.
NOAA PEL	National Oceanographic and Atmospheric Administration, Probable Effects Threshold.
SLERA	Screening Level Ecological Risk Assessment.
USGS SEL	United States Geological Service, Severe Effects Level.

(a) Analytical data for sediment locations are in Table B-2. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-2a).

(b) The sediment ESVs are summarized on Table 2-2.

(c) Analytical data for background locations are in Table B-5.

Table 4-4b
Refinement of Sediment Risk Calculations for Aquatic Wildlife (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		SLERA ESV (b) (mg/kg)	NOAA PEL (b) (mg/kg)	USGS SEL (b) (mg/kg)	Background HQs (c) SLERA HQ	PEL HQ (unitless)	SEL HQ	SD-ED-13 SLERA HQ	PEL HQ (unitless)	SEL HQ	SD-ED-14 SLERA HQ	PEL HQ (unitless)	SEL HQ
Inorganics													
	Aluminum	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Barium	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Beryllium	---	---	---	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Cadmium	1	3.53	10	0.9	0.3	0.09	10	4	*1*	4	*1*	0.4
	Copper	18.7	197	110	0.4	0.04	0.07	3	0.3	0.5	*1*	0.09	0.2
	Lead	30.2	91.3	250	0.5	0.2	0.06	3	0.9	0.3	2	0.8	0.3
	Manganese	460	---	---	0.3	No ESV	No ESV	0.7	>Bkg/No ESV	>Bkg/No ESV	2	>Bkg/No ESV	>Bkg/No ESV
	Mercury	0.13	0.486	2	0.1	0.03	0.007	0.2	0.05	0.01	0.5	0.1	0.03
	Nickel	15.9	35.9	75	0.3	0.1	0.07	0.9	0.4	0.2	0.9	0.4	0.2
	Vanadium	---	---	---	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Zinc	124	315	820	4	*1*	0.6	90	30	10	40	20	6

Notes:

(yellow shading)	HQ > 1
---	Not available.
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/kg	Milligrams per kilogram.
ND	Not detected.
NOAA PEL	National Oceanographic and Atmospheric Administration, Probable Effects Threshold.
SLERA	Screening Level Ecological Risk Assessment.
USGS SEL	United States Geological Service, Severe Effects Level.

(a) Analytical data for sediment locations are in Table B-2. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-2b).
(b) The sediment ESVs are summarized on Table 2-2.
(c) Analytical data for background locations are in Table B-5.

Table 4-4b
Refinement of Sediment Risk Calculations for Aquatic Wildlife (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	SLERA ESV (b) (mg/kg)	NOAA PEL (b) (mg/kg)	USGS SEL (b) (mg/kg)	Background HQs (c) SLERA HQ	Background HQs (c) PEL HQ (unitless)	Background HQs (c) SEL HQ	SD-ED-15 SLERA HQ	SD-ED-15 PEL HQ (unitless)	SD-ED-15 SEL HQ	SD-ED-16 SLERA HQ	SD-ED-16 PEL HQ (unitless)	SD-ED-16 SEL HQ
Inorganics												
Aluminum	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Barium	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Beryllium	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Cadmium	1	10	10	0.9	0.3	0.09	2	0.7	0.2	9	3	0.9
Copper	18.7	110	110	0.4	0.04	0.07	<Bkg	<Bkg	<Bkg	3	0.3	0.5
Lead	30.2	250	250	0.5	0.2	0.06	0.7	0.2	0.08	3	*1*	0.3
Manganese	460	---	---	0.3	No ESV	No ESV	2	>Bkg/No ESV	>Bkg/No ESV	0.8	>Bkg/No ESV	>Bkg/No ESV
Mercury	0.13	2	2	0.1	0.03	0.007	ND	ND	ND	*1*	0.3	0.08
Nickel	15.9	75	75	0.3	0.1	0.07	0.5	0.2	0.1	*1*	0.5	0.2
Vanadium	---	---	---	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Zinc	124	820	820	4	*1*	0.6	4	2	0.6	70	30	10

Notes:

(yellow box)	HQ > 1
---	Not available.
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/kg	Milligrams per kilogram.
ND	Not detected.
NOAA PEL	National Oceanographic and Atmospheric Administration, Probable Effects Threshold.
SLERA	Screening Level Ecological Risk Assessment.
USGS SEL	United States Geological Service, Severe Effects Level.

(a) Analytical data for sediment locations are in Table B-2. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-2b).
(b) The sediment ESVs are summarized on Table 2-2.
(c) Analytical data for background locations are in Table B-5.

Table 4-4c
Refinement of Sediment Risk Calculations for Aquatic Wildlife (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		SLERA ESV (b) (mg/kg)	NOAA PEL (b) (mg/kg)	USGS SEL (b) (mg/kg)	Background HQs (c) SLERA HQ	Background HQs (c) PEL HQ (unitless)	Background HQs (c) SEL HQ	SD-WD-09 SLERA HQ	SD-WD-09 PEL HQ (unitless)	SD-WD-09 SEL HQ	SD-WD-09d SLERA HQ	SD-WD-09d PEL HQ (unitless)	SD-WD-09d SEL HQ
Inorganics													
	Cadmium	1	3.53	10	*1*	0.4	0.1	600	200	60	600	200	60
	Copper	18.7	197	110	2	0.2	0.3	3	0.3	0.5	3	0.3	0.6
	Lead	30.2	91.3	250	2	0.5	0.2	7	2	0.9	8	3	*1*
	Mercury	0.13	0.486	2	0.4	0.1	0.03	10	3	0.7	10	3	0.9
	Nickel	15.9	35.9	75	*1*	0.4	0.2	2	0.8	0.4	2	0.7	0.3
	Selenium	---	---	---	Bkg ND	Bkg ND	Bkg ND	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Vanadium	---	---	---	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	<Bkg	<Bkg	<Bkg
	Zinc	124	315	820	7	3	*1*	100	40	10	80	30	10
Organics													
	2-Butanone	---	---	---	Bkg ND	Bkg ND	Bkg ND	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Acetone	0.0099	---	---	Bkg ND	Bkg ND	Bkg ND	3	>Bkg/No ESV	>Bkg/No ESV	5	>Bkg/No ESV	>Bkg/No ESV
	cis-1,2-Dichloroethene	---	---	---	Bkg ND	Bkg ND	Bkg ND	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV

Notes:

(yellow box)	HQ > 1
---	Not available.
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/kg	Milligrams per kilogram.
ND	Not detected.
NOAA PEL	National Oceanographic and Atmospheric Administration, Probable Effects Threshold.
SLERA	Screening Level Ecological Risk Assessment.
USGS SEL	United States Geological Service, Severe Effects Level.

(a) Analytical data for sediment locations are in Table B-2. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-2c).
(b) The sediment ESVs are summarized on Table 2-2.
(c) Analytical data for background locations are in Table B-5.

Table 4-4d
Refinement of Sediment Risk Calculations for Aquatic Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	SLERA ESV (b) (mg/kg)	NOAA PEL (b) (mg/kg)	USGS SEL (b) (mg/kg)	Background HQs (c) SLERA HQ (unitless)	Background HQs (c) PEL HQ (unitless)	Background HQs (c) SEL HQ (unitless)	SD-WD-01 SLERA HQ (unitless)	SD-WD-01 PEL HQ (unitless)	SD-WD-01 SEL HQ (unitless)	SD-WD-02 SLERA HQ (unitless)	SD-WD-02 PEL HQ (unitless)	SD-WD-02 SEL HQ (unitless)	SD-WD-03 SLERA HQ (unitless)	SD-WD-03 PEL HQ (unitless)	SD-WD-03 SEL HQ (unitless)	SD-WD-04 SLERA HQ (unitless)	SD-WD-04 PEL HQ (unitless)	SD-WD-04 SEL HQ (unitless)	SD-WD-06 SLERA HQ (unitless)	SD-WD-06 PEL HQ (unitless)	SD-WD-06 SEL HQ (unitless)
Inorganics																					
Aluminum	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Arsenic	7.24	17	33	2	0.9	0.5	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Barium	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Cadmium	1	3.53	10	*1*	0.4	0.1	<Bkg	<Bkg	<Bkg	2	0.5	0.2	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	20	7	2
Copper	18.7	197	110	2	0.2	0.3	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	3	0.3	0.5
Iron	20,000	---	---	0.8	No ESV	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	*1*	>Bkg/No ES	Bkg/No ESV
Lead	30.2	91.3	250	2	0.5	0.2	<Bkg	<Bkg	<Bkg	2	0.5	0.2	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	10	3	*1*
Mercury	0.13	0.486	2	0.4	0.1	0.03	0.5	0.1	0.03	0.5	0.1	0.03	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	7	2	0.5
Nickel	15.9	35.9	75	*1*	0.4	0.2	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Selenium	---	---	---	Bkg ND	Bkg ND	Bkg ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	124	315	820	7	3	*1*	<Bkg	<Bkg	<Bkg	10	4	2	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	80	30	10

Notes:

(yellow highlight)	HQ > 1
---	Not available.
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/kg	Milligrams per kilogram.
ND	Not detected.
NOAA PEL	National Oceanographic and Atmospheric Administration, Probable Effects Threshold.
SLERA	Screening Level Ecological Risk Assessment.
USGS SEL	United States Geological Service, Severe Effects Level.

(a) Analytical data for sediment locations are in Table B-2. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-2d).
(b) The sediment ESVs are summarized on Table 2-2.
(c) Analytical data for background locations are in Table B-5.

Table 4-4d
Refinement of Sediment Risk Calculations for Aquatic Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	SLERA ESV (b) (mg/kg)	NOAA PEL (b) (mg/kg)	USGS SEL (b) (mg/kg)	Background HQs (c) SLERA HQ	Background HQs (c) PEL HQ (unitless)	Background HQs (c) SEL HQ	SD-WD-07 SLERA HQ	SD-WD-07 PEL HQ (unitless)	SD-WD-07 SEL HQ	SD-WD-08 SLERA HQ	SD-WD-08 PEL HQ (unitless)	SD-WD-08 SEL HQ
Inorganics												
Aluminum	---	---	---	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Arsenic	7.24	17	33	2	0.9	0.5	3	*1*	0.8	<Bkg	<Bkg	<Bkg
Barium	---	---	---	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Cadmium	1	3.53	10	*1*	0.4	0.1	100	30	10	20	5	2
Copper	18.7	197	110	2	0.2	0.3	20	2	3	5	0.5	0.9
Iron	*20,000*	---	---	*0.8*	No ESV	No ESV	2	>Bkg/No ESV	>Bkg/No ESV	*1*	>Bkg/No ESV	>Bkg/No ESV
Lead	30.2	91.3	250	2	0.5	0.2	90	30	10	10	5	2
Mercury	0.13	0.486	2	0.4	0.1	0.03	*1*	0.3	0.08	10	3	0.7
Nickel	15.9	35.9	75	*1*	0.4	0.2	2	0.8	0.4	2	0.7	0.3
Selenium	---	---	---	Bkg ND	Bkg ND	Bkg ND	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	ND	ND	ND
Zinc	124	315	820	7	3	*1*	200	70	30	60	20	9

Notes:
(highlighted) HQ > 1
--- Not available.
1 HQ is between 1.0 and 1.5.
> Bkg/I The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg The detected concentration at this location is less than background.
Bkg Background.
ESV Ecotoxicity Screening Value.
HQ Hazard Quotient.
mg/kg Milligrams per kilogram.
ND Not detected.
NOAA National Oceanographic and Atmospheric Administration, Probable Effects Threshold.
SLER/ Screening Level Ecological Risk Assessment.
USGS United States Geological Service, Severe Effects Level.

(a) Analytical data for sediment locations are in Table B-2. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients tat
(b) The sediment ESVs are summarized on Table 2-2.
(c) Analytical data for background locations are in Table B-5.

Table 4-5a
Refinement of Piscivorous Wildlife Water/Dietary COPCs (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Surface Water (a) (mg/l)	EPC in Surface Water (a) (mg/l)		Eastern Drainage Background Concentration in Surface Water (b) (mg/l)	EPC > Bkg (or Bkg ND) (yes/no)	Most Sensitive Piscivore NOAEL-Based SLERA ESV (c) (mg/L)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Aluminum	0.13	0.13	m	0.17	no	NA		no	EPC < Bkg
Barium	0.071	0.071	m	0.14	no	NA		no	EPC < Bkg
Cadmium	0.0071	0.0071	m	ND	YES	0.0004367	YES	YES	EPC > Bkg; EPC > ESV
Calcium	80	80	m	88	NA			no	Essential Nutrient
Iron	0.28	0.28	m	0.28	no	NA		no	EPC < Bkg
Magnesium	27	27	m	12	NA			no	Essential Nutrient
Manganese	0.38	0.38	m	0.11	YES	---	YES	YES	EPC > Bkg; No ESV
Potassium	5.2	5.2	m	5.7	NA			no	Essential Nutrient
Sodium	41	41	m	29	NA			no	Essential Nutrient
Sulfate	160	160	m	21	YES	---	YES	YES	EPC > Bkg; No ESV
Vanadium	0.00087	0.00087	m	0.0015	no	NA		no	EPC < Bkg
Zinc	11	11	m	1.4	YES	0.085	YES	YES	EPC > Bkg; EPC > ESV

Notes:

---	Not available.	m	The EPC is the maximum concentration.
BERA	Baseline Ecological Risk Assessment.	mg/l	Milligrams per liter.
Bkg	Background.	NA	Not applicable.
COPC	Chemical of Potential Concern.	ND	Not detected.
EPC	Exposure Point Concentration.	NOAEL	No Observed Apparent Effects Level.
ESV	Ecotoxicity Screening Value.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-6a. Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Table 3-3b).
(b) Background concentrations are summarized on Table C-8a.
(c) The surface water ESVs are summarized on Table 2-3.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-5b
Refinement of Piscivorous Wildlife Water/Dietary COPCs (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Surface Water (a) (mg/l)	EPC in Surface Water (a) (mg/l)		Western Drainage Background Concentration in Surface Water (b) (mg/l)	EPC > Bkg (or Bkg ND) (yes/no)	Most Sensitive Piscivore NOAEL-Based SLERA ESV (c) (mg/L)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Barium	0.041	0.041	m	0.087	no	NA		no	EPC < Bkg
Cadmium	0.23	0.23	m	0.0058	YES	0.0004367	YES	YES	EPC > Bkg; EPC > ESV
Calcium	120	120	m	100	NA			no	Essential Nutrient
Cobalt	0.0024	0.0024	m	0.0044	no	NA		no	EPC < Bkg
Iron	0.17	0.17	m	15	no	NA		no	EPC < Bkg
Magnesium	38	38	m	26	NA			no	Essential Nutrient
Manganese	0.3	0.3	m	0.49	no	NA		no	EPC < Bkg
Potassium	17	17	m	5.4	NA			no	Essential Nutrient
Sodium	57	57	m	62	NA			no	Essential Nutrient
Sulfate	450	450	m	95	YES	---	YES	YES	EPC > Bkg; No ESV
Zinc	26	26	m	3.7	YES	0.085	YES	YES	EPC > Bkg; EPC > ESV
Organics									
cis-1,2-Dichloroethene	0.0000022	0.0000022	m	ND	YES	---	YES	YES	EPC > Bkg; No ESV
Trichloroethylene	0.0000063	0.0000063	m	ND	YES	---	YES	YES	EPC > Bkg; No ESV

Notes:

---	Not available.	m	The EPC is the maximum concentration.
BERA	Baseline Ecological Risk Assessment.	mg/l	Milligrams per liter.
Bkg	Background.	NA	Not applicable.
COPC	Chemical of Potential Concern.	ND	Not detected.
EPC	Exposure Point Concentration.	NOAEL	No Observed Apparent Effects Level.
ESV	Ecotoxicity Screening Value.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Table C-6b. Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Table 3-3a).
(b) Background concentrations are summarized on Table C-8a.
(c) The surface water ESVs are summarized on Table 3-1b.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration AND the exposure point concentration is less than the ESV.
(e) Why a constituent is (or is not) considered a COPC.

Table 4-5c
Refinement of Piscivorous Wildlife Water/Dietary COPCs (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Maximum Concentration in Surface Water (a) (mg/l)	EPC in Surface Water (a) (mg/l)		Western Drainage Background Concentration in Surface Water (b) (mg/l)	EPC > Bkg (or Bkg ND) (yes/no)	Most Sensitive Piscivore NOAEL-Based SLERA ESV (c) (mg/L)	EPC > ESV (or no ESV) (yes/no)	Carry constituent forward? (d) (yes/no)	Rationale (e)
Inorganics									
Aluminum	1.4	1.4	m	1.1	YES	0.025	YES	YES	EPC > Bkg; EPC > ESV
Barium	0.089	0.074	u	0.087	no	NA		no	EPC < Bkg
Cadmium	0.034	0.034	m	0.0058	YES	0.0004367	YES	YES	EPC > Bkg; EPC > ESV
Calcium	150	150	m	100	NA			no	Essential Nutrient
Cobalt	0.0016	0.0013	u	0.0044	no	NA		no	EPC < Bkg
Iron	3.2	2.8	u	15	no	NA		no	EPC < Bkg
Magnesium	36	35	u	26	NA			no	Essential Nutrient
Manganese	0.62	0.62	m	0.49	YES	—	YES	YES	EPC > Bkg; No ESV
Mercury	0.00003	0.00003	m	0.000034	no	NA		no	EPC < Bkg
Potassium	9.2	8.5	u	5.4	NA			no	Essential Nutrient
Selenium	0.002	0.002	m	0.0013	YES	0.0004318	YES	YES	EPC > Bkg; EPC > ESV
Silver	0.00006	0.00006	m	0.00008	no	NA		no	EPC < Bkg
Sodium	60	60	u	62	NA			no	Essential Nutrient
Sulfate	330	330	m	95	YES	—	YES	YES	EPC > Bkg; No ESV
Vanadium	0.0051	0.0038	u	0.0047	no	NA		no	EPC < Bkg
Zinc	26	26	m	3.7	YES	0.085	YES	YES	EPC > Bkg; EPC > ESV

Notes:

—	Not available.	m	The EPC is the maximum concentration.
BERA	Baseline Ecological Risk Assessment.	mg/l	Milligrams per liter.
Bkg	Background.	NA	Not applicable.
COPC	Chemical of Potential Concern.	ND	Not detected.
EPC	Exposure Point Concentration.	NOAEL	No Observed Apparent Effects Level.
ESV	Ecotoxicity Screening Value.	SLERA	Screening Level Ecological Risk Assessment.
		u	The EPC is the 95% UCL.

(a) Occurrence of constituents summarized on Table C-6c. Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Table 3-3b).
(b) Background concentrations are summarized on Table C-8a.
(c) The surface water ESVs are summarized on Table 2-3.
(d) Constituents are identified as COPCs for Step 3a of the BERA unless the exposure point concentration is less than the background concentration (or there is no background concentration) and the exposure point concentration is less than the ecological screening value.
(e) This explains why a constituent is (or is not) carried forward through the BERA.

Table 4-6a
Refinement of Risk Calculations for Piscivorous Wildlife (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Eastern Drainage Background Concentration in Surface Water (b) (mg/L)	Mink NOAEL and LOAEL-Based HQs (c) NOAEL (unitless)	Mink LOAEL (unitless)	Great Blue Heron NOAEL (unitless)	Great Blue Heron LOAEL (unitless)	EPC in Surface Water (d) (mg/L)		Mink NOAEL and LOAEL-Based HQs (c) NOAEL (unitless)	Mink LOAEL (unitless)	Great Blue Heron NOAEL (unitless)	Great Blue Heron LOAEL (unitless)
Inorganics											
Cadmium	ND					0.0071	m	20	2	7	0.8
Manganese	0.11	NA	NA	NA	NA	0.38	m	NA	NA	NA	NA
Sulfate	21	NA	NA	NA	NA	160	m	NA	NA	NA	NA
Zinc	1.4	2	0.8	20	2	11	m	10	6	100	10

Notes:

(shaded)	HQ > 1
EPC	Exposure Point Concentration.
LOAEL	Lowest Observed Apparent Effects Concentration.
m	The EPC is the maximum concentration.
mg/l	Milligrams per liter.
NA	Not available or not applicable.
NOAEL	No Observed Apparent Effects Level.

(a) Only those constituents identified as Step 3A COPCs are retained for calculation of HQs (Table 4-5a).
(b) Background concentrations are summarized on Table C-8a.
(c) Mink and heron NOAELs and LOAELs are summarized in Appendix D (Table D-1a). The HQ is the ratio of the EPC to the appropriate ESV (either the NOAEL or the LOAEL). HQs are rounded to 1 significant digit.
(d) Occurrence of constituents summarized on Table C-6a.

Table 4-6b
Refinement of Risk Calculations for Piscivorous Wildlife (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Western Drainage Background Concentration in Surface Water (b) (mg/L)	Mink NOAEL and LOAEL-Based HQs (c) NOAEL (unitless)	Mink LOAEL	Great Blue Heron NOAEL	Great Blue Heron LOAEL	EPC in Surface Water (d) (mg/L)		Mink NOAEL and LOAEL-Based HQs (c) NOAEL (unitless)	Mink LOAEL	Great Blue Heron NOAEL	Great Blue Heron LOAEL
Inorganics											
Cadmium	0.0058	10	1	6	0.6	0.23	m	500	50	200	30
Sulfate	95	NA	NA	NA	NA	450	m	NA	NA	NA	NA
Zinc	3.7	4	2	40	5	26	m	30	10	300	30
cis-1,2-Dichloroethene	ND					0.0000022	m	NA	NA	NA	NA
Trichloroethylene	ND					0.0000063	m	NA	NA	NA	NA

Notes:
HQ > 1
EPC *Exposure Point Concentration.*
LOAEL Lowest Observed Apparent Effects Concentration.
m The EPC is the maximum concentration.
mg/l Milligrams per liter.
NA *Not available or not applicable.*
NOAEL No Observed Apparent Effects Level.

(a) Only those constituents identified as Step 3A COPCs are retained for calculation of HQs (Table 4-5b).
(b) Background concentrations are summarized on Table C-8a.
(c) Mink and heron NOAELs and LOAELs are summarized in Appendix D (Table D-1a). The HQ is the ratio of the EPC to the appropriate ESV (either the NOAEL or the LOAEL). HQs are rounded to 1 significant digit.
(d) Occurrence of constituents summarized on Table C-6b.

Table 4-6c
Refinement of Risk Calculations for Piscivorous Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Western Drainage Background Concentration in Surface Water (b) (mg/L)	Mink NOAEL (unitless)	Mink LOAEL (unitless)	Great Blue Heron NOAEL (unitless)	Great Blue Heron LOAEL (unitless)	EPC in Surface Water (d) (mg/L)		Mink NOAEL (unitless)	Mink LOAEL (unitless)	Great Blue Heron NOAEL (unitless)	Great Blue Heron LOAEL (unitless)
Inorganics											
Aluminum	1.1	40	4	0.4	NA	1.4	m	60	6	0.5	NA
Cadmium	0.0058	10	*1*	6	0.6	0.034	m	80	8	30	4
Manganese	0.49	NA	NA	NA	NA	0.62	m	NA	NA	NA	NA
Selenium	0.0013	3	2	*1*	0.6	0.002	m	5	3	2	0.9
Sulfate	95	NA	NA	NA	NA	330	m	NA	NA	NA	NA
Zinc	3.7	4	2	40	5	26	m	30	10	300	30

Notes:

(shaded)	HQ > 1
EPC	Exposure Point Concentration.
LOAEL	Lowest Observed Apparent Effects Concentration.
m	The EPC is the maximum concentration.
mg/l	Milligrams per liter.
NA	Not available or not applicable.
NOAEL	No Observed Apparent Effects Level.

(a) Only those constituents identified as Step 3A COPCs are retained for calculation of HQs (Table 4-5c).
(b) Background concentrations are summarized on Table C-8a.
(c) Mink and heron NOAELs and LOAELs are summarized in Appendix D (Table D-1a). The HQ is the ratio of the EPC to the appropriate ESV (either the NOAEL or the LOAEL). HQs are rounded to 1 significant digit.
(d) Occurrence of constituents summarized on Table C-6c.

Table 4-7a
Location-Specific HQs for Piscivorous Wildlife (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Mink (Piscivore) (b) NOAEL (mg/L)	Mink (Piscivore) (b) LOAEL (mg/L)	Great Blue Heron (Piscivore) (b) NOAEL (mg/L)	Great Blue Heron (Piscivore) (b) LOAEL (mg/L)	Background HQs (c) Mink HQs NOAEL (unitless)	Background HQs (c) Mink HQs LOAEL (unitless)	Background HQs (c) Heron HQs NOAEL (unitless)	Background HQs (c) Heron HQs LOAEL (unitless)	SW-ED-13 Mink HQs NOAEL (unitless)	SW-ED-13 Mink HQs LOAEL (unitless)	SW-ED-13 Heron HQs NOAEL (unitless)	SW-ED-13 Heron HQs LOAEL (unitless)	SW-ED-16 Mink HQs NOAEL (unitless)	SW-ED-16 Mink HQs LOAEL (unitless)	SW-ED-16 Heron HQs NOAEL (unitless)	SW-ED-16 Heron HQs LOAEL (unitless)
Inorganics																
Cadmium	0.00044	0.004367	0.001	0.009	Bkg ND	Bkg ND	Bkg ND	Bkg ND	20	2	7	0.8	ND	ND	ND	ND
Manganese	---	---	---	---	No ESV	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	<Bkg	<Bkg	<Bkg	<Bkg
Sulfate	---	---	---	---	No ESV	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Zinc	0.929	1.858	0.085	0.771	2	0.8	20	2	10	6	100	10	<Bkg	<Bkg	<Bkg	<Bkg

Notes:

(highlighted)	HQ > 1
< Bkg	Indicates that the detected concentration at this location is less than background.
> Bkg	Indicates that the detected concentration at this location is greater than background and there are no screening criteria.
Bkg	Background.
HQ	Hazard Quotient.
LOAEL	Lowest Observed Apparent Effects Concentration.
mg/L	Milligrams per liter.
NA	Not available or not applicable.
ND	Not detected.
NOAEL	No Observed Apparent Effects Level.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-6a).
(b) The surface water ESVs are summarized on Table 2-3.
(c) Analytical data for background locations are in Table B-4.

Table 4-7b
Location-Specific HQs for Piscivorous Wildlife (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Mink (Piscivore) (b)		Great Blue Heron (Piscivore) (b)		Background HQs (c)				SW-WD-9				SW-WD-PN			
					Mink HQs		Heron HQs		Mink HQs		Heron HQs		Mink HQs		Heron HQs	
	NOAEL (mg/L)	LOAEL (mg/L)	NOAEL (mg/L)	LOAEL (mg/L)	NOAEL (unitless)	LOAEL	NOAEL	LOAEL	NOAEL (unitless)	LOAEL	NOAEL	LOAEL	NOAEL (unitless)	LOAEL	NOAEL	LOAEL
Inorganics																
Cadmium	0.00044	0.004367	0.001	0.009	10	1	6	0.6	500	50	200	30	200	20	90	10
Sulfate	---	---	---	---	No ESV	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Zinc	0.929	1.858	0.085	0.771	4	2	40	5	30	10	300	30	20	9	200	20
Organics																
cis-1,2-Dichloroethene	---	---	---	---	Bkg ND	Bkg ND	Bkg ND	Bkg ND	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Trichloroethylene	---	---	---	---	Bkg ND	Bkg ND	Bkg ND	Bkg ND	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV

Notes:

(highlighted)	HQ > 1
---	Not available.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.
NOAEL	No Observed Apparent Effects Level.
LOAEL	Lowest Observed Apparent Effects Concentration.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-6b).
(b) The surface water ESVs are summarized on Table 2-3.
(c) Analytical data for background locations are in Table B-4.

Table 4-7b
Location-Specific HQs for Piscivorous Wildlife (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		Mink (Piscivore) (b) NOAEL (mg/L)	Mink (Piscivore) (b) LOAEL (mg/L)	Great Blue Heron (Piscivore) (b) NOAEL (mg/L)	Great Blue Heron (Piscivore) (b) LOAEL (mg/L)	SW-WD-PS Mink HQs NOAEL (unitless)	SW-WD-PS Mink HQs LOAEL (unitless)	SW-WD-PS Heron HQs NOAEL (unitless)	SW-WD-PS Heron HQs LOAEL (unitless)
Inorganics									
	Cadmium	0.0004367	0.004367	0.001	0.009	200	20	70	8
	Sulfate	---	---	---	---	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Zinc	0.929	1.858	0.085	0.771	20	8	200	20
Organics									
	cis-1,2-Dichloroethene	---	---	---	---	ND	ND	ND	ND
	Trichloroethylene	---	---	---	---	ND	ND	ND	ND

Notes:

(yellow box)	HQ > 1
---	Not available.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.
NOAEL	No Observed Apparent Effects Level.
LOAEL	Lowest Observed Apparent Effects Concentration.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-6b).

(b) The surface water ESVs are summarized on Table 2-3.

(c) Analytical data for background locations are in Table B-4.

Table 4-7c
Location-Specific HQs for Piscivorous Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Mink (Piscivore) (b) NOAEL (mg/L)	Mink (Piscivore) (b) LOAEL (mg/L)	Great Blue Heron (Piscivore) (b) NOAEL (mg/L)	Great Blue Heron (Piscivore) (b) LOAEL (mg/L)	Background HQs (c) Mink HQs NOAEL (unitless)	Background HQs (c) Mink HQs LOAEL (unitless)	Background HQs (c) Heron HQs NOAEL (unitless)	Background HQs (c) Heron HQs LOAEL (unitless)	SW-WD-6a Mink HQs NOAEL (unitless)	SW-WD-6a Mink HQs LOAEL (unitless)	SW-WD-6a Heron HQs NOAEL (unitless)	SW-WD-6a Heron HQs LOAEL (unitless)	SW-WD-6b Mink HQs NOAEL (unitless)	SW-WD-6b Mink HQs LOAEL (unitless)	SW-WD-6b Heron HQs NOAEL (unitless)	SW-WD-6b Heron HQs LOAEL (unitless)
<u>Inorganics</u>																
Aluminum	0.025	0.253	2.699	---	40	4	0.4	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	ND	ND	ND	ND
Cadmium	0.00044	0.004367	0.001	0.009	10	***1***	6	0.6	40	4	20	2	10	***1***	6	0.6
Manganese	---	---	---	---	No ESV	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	<Bkg	<Bkg	<Bkg	<Bkg
Selenium	0.00043	0.0007124	0.001094	0.002188	3	2	***1***	0.6	ND	ND	ND	ND	5	3	2	0.9
Sulfate	---	---	---	---	No ESV	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	ND	ND	ND	ND
Zinc	0.929	1.858	0.085	0.771	4	2	40	5	20	8	200	20	4	2	50	5

Notes:

[highlighted cell]	HQ > 1
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.
NOAEL	No Observed Apparent Effects Level.
LOAEL	Lowest Observed Apparent Effects Concentration.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-6c).
(b) The surface water ESVs are summarized on Table 2-3.
(c) Analytical data for background locations are in Table B-4.

Table 4-7c
Location-Specific HQs for Piscivorous Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Mink (Piscivore) (b) NOAEL (mg/L)	Mink (Piscivore) (b) LOAEL (mg/L)	Great Blue Heron (Piscivore) (b) NOAEL (mg/L)	Great Blue Heron (Piscivore) (b) LOAEL (mg/L)	Background HQs (c) Mink HQs NOAEL (unitless)	Background HQs (c) Mink HQs LOAEL (unitless)	Background HQs (c) Heron HQs NOAEL (unitless)	Background HQs (c) Heron HQs LOAEL (unitless)	SW-WD-6bd Mink HQs NOAEL (unitless)	SW-WD-6bd Mink HQs LOAEL (unitless)	SW-WD-6bd Heron HQs NOAEL (unitless)	SW-WD-6bd Heron HQs LOAEL (unitless)	SW-WD-12 Mink HQs NOAEL (unitless)	SW-WD-12 Mink HQs LOAEL (unitless)	SW-WD-12 Heron HQs NOAEL (unitless)	SW-WD-12 Heron HQs LOAEL (unitless)
Inorganics																
Aluminum	0.025	0.253	2.699	---	40	4	0.4	No ESV	ND	ND	ND	ND	60	6	0.5	>Bkg/No ESV
Cadmium	0.0004367	0.004367	0.001	0.009	10	*1*	6	0.6	20	2	9	*1*	<Bkg	<Bkg	<Bkg	<Bkg
Manganese	---	---	---	---	No ESV	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Selenium	0.0004318	0.0007124	0.001094	0.002188	3	2	*1*	0.6	4	3	2	0.9	3	2	*1*	0.6
Sulfate	---	---	---	---	No ESV	No ESV	No ESV	No ESV	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	0.929	1.858	0.085	0.771	4	2	40	5	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg

Notes:

(yellow box)	HQ > 1
1	HQ is between 1.0 and 1.5.
> Bkg/No	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.
NOAEL	No Observed Apparent Effects Level.
LOAEL	Lowest Observed Apparent Effects Concentration.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-6c).

(b) The surface water ESVs are summarized on Table 2-3.

(c) Analytical data for background locations are in Table B-4.

Table 4-7c
Location-Specific HQs for Piscivorous Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Mink (Piscivore) (b)		Great Blue Heron (Piscivore) (b)		Background HQs (c)				SW-WD-7				SW-WD-7D			
					Mink HQs		Heron HQs		Mink HQs		Heron HQs		Mink HQs		Heron HQs	
	NOAEL (mg/L)	LOAEL (mg/L)	NOAEL (mg/L)	LOAEL (mg/L)	NOAEL (unitless)	LOAEL	NOAEL	LOAEL	NOAEL (unitless)	LOAEL	NOAEL	LOAEL	NOAEL (unitless)	LOAEL	NOAEL	LOAEL
Inorganics																
Aluminum	0.025	0.253	2.699	---	40	4	0.4	No ESV	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	0.0004367	0.004367	0.001	0.009	10	*1*	6	0.6	80	8	30	4	80	8	30	4
Manganese	---	---	---	---	No ESV	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg	<Bkg
Selenium	0.0004318	0.0007124	0.001094	0.002188	3	2	*1*	0.6	ND	ND	ND	ND	ND	ND	ND	ND
Sulfate	---	---	---	---	No ESV	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
Zinc	0.929	1.858	0.085	0.771	4	2	40	5	30	10	300	30	30	10	300	30

Notes:

(yellow shading)	HQ > 1
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.
NOAEL	No Observed Apparent Effects Level.
LOAEL	Lowest Observed Apparent Effects Concentration.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-6c).
(b) The surface water ESVs are summarized on Table 2-3.
(c) Analytical data for background locations are in Table B-4.

Table 4-7c
Location-Specific HQs for Piscivorous Wildlife (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)		Mink (Piscivore) (b) NOAEL (mg/L)	Mink (Piscivore) (b) LOAEL (mg/L)	Great Blue Heron (Piscivore) (b) NOAEL (mg/L)	Great Blue Heron (Piscivore) (b) LOAEL (mg/L)	Background HQs (c) Mink HQs NOAEL (unitless)	Background HQs (c) Mink HQs LOAEL (unitless)	Background HQs (c) Heron HQs NOAEL (unitless)	Background HQs (c) Heron HQs LOAEL (unitless)	SW-WD-8 Mink HQs NOAEL (unitless)	SW-WD-8 Mink HQs LOAEL (unitless)	SW-WD-8 Heron HQs NOAEL (unitless)	SW-WD-8 Heron HQs LOAEL (unitless)
Inorganics													
	Aluminum	0.025	0.253	2.699	---	40	4	0.4	No ESV	ND	ND	ND	ND
	Cadmium	0.0004367	0.004367	0.001	0.009	10	*1*	6	0.6	<Bkg	<Bkg	<Bkg	<Bkg
	Manganese	---	---	---	---	No ESV	No ESV	No ESV	No ESV	<Bkg	<Bkg	<Bkg	<Bkg
	Selenium	0.0004318	0.0007124	0.001094	0.002188	3	2	*1*	0.6	ND	ND	ND	ND
	Sulfate	---	---	---	---	No ESV	No ESV	No ESV	No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV	>Bkg/No ESV
	Zinc	0.929	1.858	0.085	0.771	4	2	40	5	<Bkg	<Bkg	<Bkg	<Bkg

Notes:

(yellow shading)	HQ > 1
1	HQ is between 1.0 and 1.5.
> Bkg/No ESV	The detected concentration at this location is greater than background and there are no screening criteria.
< Bkg	The detected concentration at this location is less than background.
Bkg	Background.
ESV	Ecotoxicity Screening Value.
HQ	Hazard Quotient.
mg/L	Milligrams per liter.
ND	Not detected.
SLERA	Screening level ecological risk assessment.
NOAEL	No Observed Apparent Effects Level.
LOAEL	Lowest Observed Apparent Effects Concentration.

(a) Analytical data for surface water locations are in Table B-1. Only those constituents identified earlier in the BERA are carried forward into this location-specific hazard quotients table (Table 4-6c).

(b) The surface water ESVs are summarized on Table 2-3.

(c) Analytical data for background locations are in Table B-4.

Table 4-8
Refinement of Terrestrial Wildlife COPCs (On Site: Combined Soil)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	From SLERA (b)			SURFACE WATER				SOIL				Carry Constituent Forward? (d)		
	COPC for Deer Mouse?	COPC for American Robin?	COPC for Red-Tailed Hawk?	EPC in Surface Water (a) (mg/l)		Western Drainage Background Concentration in Surface Water (c) (mg/l)	EPC > Bkg OR Bkg ND (yes/no)	EPC in Soil (a) (mg/kg)		Background Concentration in Soil (c) (mg/kg)	EPC > Bkg OR Bkg ND	BERA COPC for Deer Mouse?	BERA COPC for American Robin?	BERA COPC for Red-Tailed Hawk?
Inorganics														
Arsenic	YES	no	no	ND		0.0023	no	8.3	u	11.3	no	no	no	no
Cadmium	YES	YES	YES	0.23	m	0.0058	YES	73	u	0.5	YES	YES	YES	YES
Chromium	no	YES	no	ND		0.0016	no	29	u	13	YES	no	YES	no
Copper	no	no	no	0.0026	m	0.0059	no	19	u	12	YES	no	no	no
Lead	YES	YES	no	0.0032	m	0.0038	no	23	u	20.9	YES	YES	YES	no
Mercury	no	YES	no	ND		0.000034	no	0.057	u	0.05	YES	no	YES	no
Nickel	YES	no	no	0.036	m	0.013	YES	22	u	13	YES	YES	no	no
Selenium	YES	no	no	ND		0.0013	no	0.55	u	ND	YES	YES	no	no
Silver	no	no	no	ND		0.00008	no	0.094	u	ND	YES	no	no	no
Zinc	YES	YES	YES	26	m	3.7	YES	4,600	u	60.2	YES	YES	YES	YES

Notes:

BERA	Baseline Ecological Risk Assessment.	m	The EPC is the maximum concentration.
Bkg	Background.	mg/kg	Milligrams per kilogram.
COPC	Chemical of Potential Concern.	mg/L	Milligrams per liter.
EPC	Exposure Point Concentration.	ND	Not detected.
ESV	Ecotoxicity Screening Value.	SLERA	Screening Level Ecological Risk Assessment.

(a) Occurrence of constituents summarized on Tables C-2a and C-4.
(b) Only those constituents identified in Step 2 of the SLERA are carried forward into Step 3a of the BERA (Tables 3-4a, 3-4b, 3-4c).
(c) Background concentrations are summarized on Tables C-8a and C-8c.
(d) A constituent is carried forward if it was a COPC for a specific receptor in the SLERA AND either the surface water or soil EPC is greater than the background concentration.

Table 4-9a
Refinement of Deer Mouse Risk Calculations (On Site, Combined Soil)
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	On Site Exposure Point Concentration (b) In Soil (mg/kg)	In Water (mg/L)	Median Uptake Factors (c) Vegetation (mg COPC/kg dw tissue)/(mg COPC/kg dw soil)	Invertebrate	Estimated Dietary Tissue Concentrations (d) Vegetation (mg/kg)	Invertebrate	COPC Intake (d) From Soil (mg/kg bw-d)	From Water	From Vegetation	From Invertibrates	Estimated Dietary Ingestion (d) (mg/kg bw-d)	Reference Toxicity Values (e) NOAEL	LOAEL	NOAEL HQ (f) (Unitless)	LOAEL HQ (f) (Unitless)
Metals															
Cadmium	73	0.23	0.586	7.708	43	560	0.236	0.034	4.23	38.3	43	2.12	19.5	20	2
Lead	23	0.0032	0.0389	0.266	0.89	6.1	0.0745	0.000472	0.0875	0.417	0.58	17.6	162	0.03	0.004
Nickel	22	0.036	0.018	1.059	0.4	23	0.0712	0.00531	0.0393	1.57	1.7	87.9	162	0.02	0.01
Selenium	0.55	ND	0.672	0.985	0.37	0.54	0.00178	NA	0.0364	0.0369	0.075	0.44	0.667	0.2	0.1
Zinc	4,600	26	0.366	3.201	1,700	15,000	14.9	3.84	167	1,030	1,200	352	647	3	2

Notes:

(shaded)	HQ > 1	dw	Dry weight.
1	HQ is between 1.0 and 1.5.	mg/L	Milligrams per liter.
COPC	Constituent of Potential Concern.	mg/kg	Milligrams per kilogram.
NOAEL	No observed adverse effects level.	mg/kg bw-d	Milligrams per kilogram of body weight per day.
HQ	Hazard quotient.	NA	Not Applicable.
		ND	Not detected.

(a) Only those constituents identified on Table 4-8 are included on this table.
(b) The occurrence of constituents is summarized on Table C-2a and Table C-4.
(c) Refer to Table D-4 for uptake factor compilation and references.
(d) Formulae for estimated tissue concentrations and dietary ingestion scenarios are presented in Table D-2a.
(e) Refer to Table D-1b for reference toxicity value summary.
(f) The HQ is the ratio of the maximum estimated dietary ingestion of a constituent to the appropriate reference toxicity value. HQs are rounded to 1 significant digit.

Table 4-9b

Refinement of American Robin Risk Calculations (On Site, Combined Soil)

Eagle Zinc

Hillsboro, Illinois

Constituent (a)	On Site Exposure Point Concentration (b) In Soil (mg/kg)	In Water (mg/L)	Median Uptake Factors (c) Vegetation (mg COPC/kg dw tissue)/(mg COPC/kg dw soil)	Invertebrate	Estimated Dietary Tissue Concentrations (d) Vegetation (mg/kg)	Invertebrate	COPC Intake (d) From Soil (mg/kg bw-d)	From Water	From Vegetation	From Invertibrates	Estimated Dietary Ingestion (d) (mg/kg bw-d)	Reference Toxicity Values (e) NOAEL	LOAEL	NOAEL HQ (f) (Unitless)	LOAEL HQ (f) (Unitless)
Metals															
Cadmium	73	0.23	0.586	7.708	43	560	1.71	0.0312	5.6	44.7	26	1.45	20	20	*1*
Chromium	29	ND	NA	0.306	NA	8.9	0.68	NA	NA	0.71	0.7	1	5	0.7	0.1
Lead	23	0.0032	0.0389	0.266	0.89	6.1	0.54	0.000435	0.116	0.486	0.57	3.85	NA	0.1	NA
Mercury	0.057	ND	0.652	1.693	0.037	0.097	0.001	NA	0.00481	0.00774	0.0069	0.45	0.9	0.02	0.008
Zinc	4,600	26	0.366	3.201	1,700	15,000	108	3.53	221	1,200	770	14.5	131	50	6

Notes:

(yellow box)	HQ > 1
1	HQ is between 1.0 and 1.5.
COPC	Constituent of Potential Concern.
NOAEL	No observed adverse effects level.
HQ	Hazard quotient.
dw	Dry weight.
mg/L	Milligrams per liter.
mg/kg	Milligrams per kilogram.
mg/kg bw-d	Milligrams per kilogram of body weight per day.
NA	Not Applicable.
ND	Not detected.

(a) Only those constituents identified on Table 4-8 are included on this table.
(b) The occurrence of constituents is summarized on Table C-2a and Table C-4.
(c) Refer to Table D-4 for uptake factor compilation and references.
(d) Formulae for estimated tissue concentrations and dietary ingestion scenarios are presented in Table D-2b.
(e) Refer to Table D-1c for reference toxicity value summary.
(f) The HQ is the ratio of the maximum estimated dietary ingestion of a constituent to the appropriate reference toxicity value. HQs are rounded to 1 significant digit.

Table 4-9c
Refinement of Red-Tailed Hawk Risk Calculations (On Site, Combined Soil)
Eagle Zinc
Hillsboro, Illinois

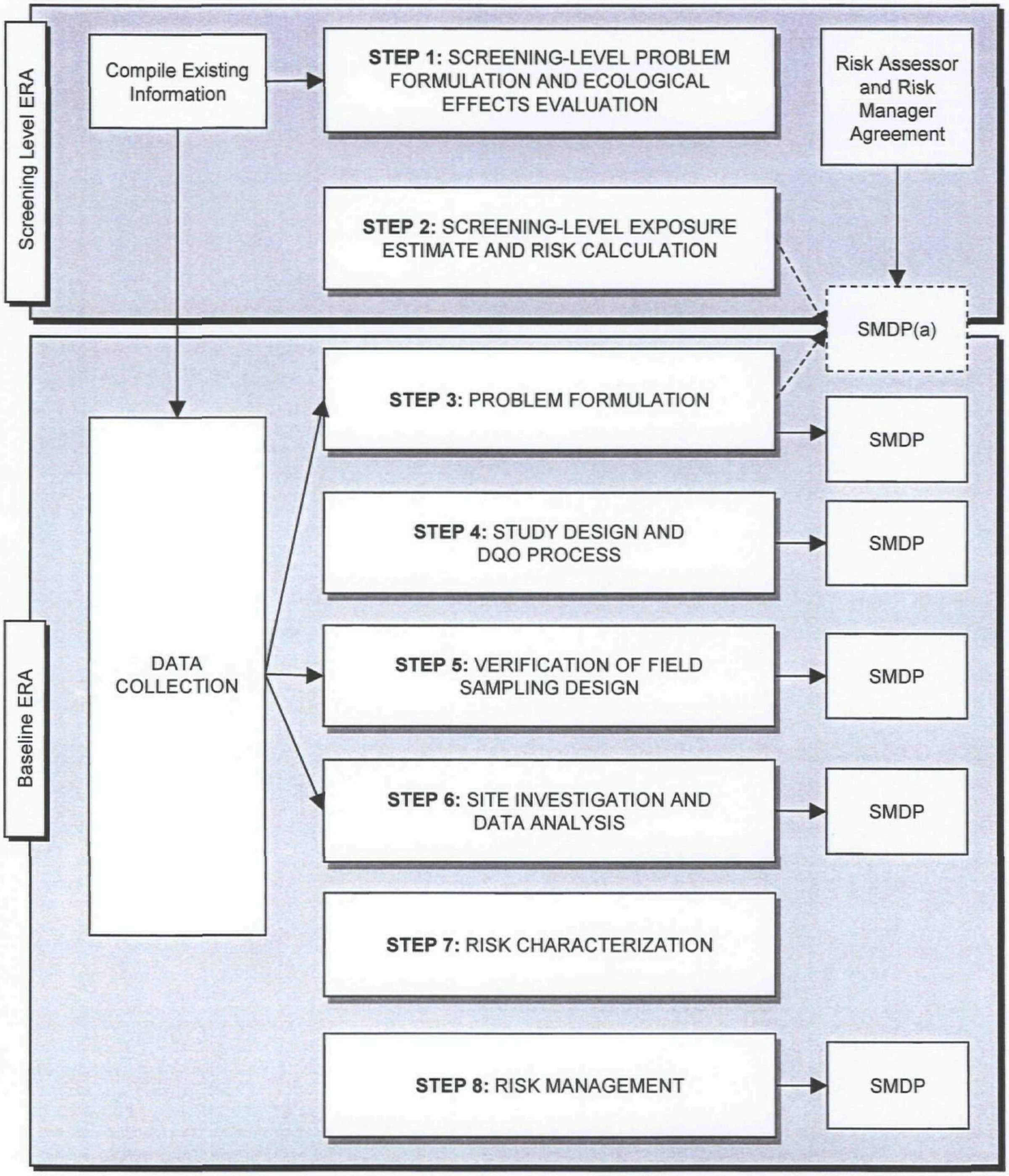
Constituent (a)	On Site Exposure Point Concentration (b) In Soil (mg/kg)	On Site Exposure Point Concentration (b) In Water (mg/L)	Median Uptake Factors For Four Types of Mammals (c) General (mg COPC/kg dw tissue)/(mg COPC/kg dw soil)	Insectivore	Herbivore	Omnivore	Estimated Dietary Tissue Conc. (d) (mg/kg)	COPC Intake (d) From Water (mg/kg bw-d)	COPC Intake (d) From Mammals (mg/kg bw-d)	Estimated Dietary Ingestion (d) (mg/kg bw-d)	Reference Toxicity Values (e) NOAEL (mg/kg bw-d)	Reference Toxicity Values (e) LOAEL (mg/kg bw-d)	NOAEL HQ (f) (Unitless)	LOAEL HQ (f) (Unitless)
Metals														
Cadmium	73	0.23	0.3333	2.105	0.1258	0.1217	49	0.013	2.55	0.73	1.45	20	0.5	0.04
Zinc	4,600	26	0.7717	0.83277	0.50429	0.55772	3,100	1.47	161	46	14.5	131	3	0.4

Notes:

(highlighted)	HQ > 1	mg/L	Milligrams per liter.
COPC	Constituent of Potential Concern.	mg/kg	Milligrams per kilogram.
NOAEL	No observed adverse effects level.	mg/kg bw-d	Milligrams per kilogram of body weight per day.
HQ	Hazard quotient.	NA	Not Applicable.
dw	Dry weight.	ND	Not detected.

(a) Only those constituents identified on Table 4-8 are included on this table.
(b) The occurrence of constituents is summarized on Table C-2a and Table C-4.
(c) Refer to Table D-4 for uptake factor compilation and references.
(d) Formulae for estimated tissue concentrations and dietary ingestion scenarios are presented in Table D-2c.
(e) Refer to Table D-1c for reference toxicity value summary.
(f) The HQ is the ratio of the maximum estimated dietary ingestion of a constituent to the appropriate reference toxicity value. HQs are rounded to 1 significant digit.

Figure 1-1
Eight-Step Ecological Risk Assessment Process



Notes:

(a) SDMP occurs EITHER after Step 2 or after Step 3a.
ERA Ecological Risk Assessment.
SMDP Scientific Management Decision Point.
Source: Adapted from USEPA, 2000a.

Figure 1-2

Expanded Eight-Step Ecological Risk Assessment Process

SLERA

STEP 1: SLERA PROBLEM FORMULATION AND ECOLOGICAL EFFECTS CHARACTERIZATION

- Screening-level problem formulation
  - Environmental Setting
  - Identification of Constituents Detected and Classification of Sediments
  - Description of Constituent Fate and Transport Pathways
  - Description of Constituent Mechanisms of Ecotoxicity
  - Description of Potentially Exposed Receptors and Conceptual Site Model
  - Identification of Potentially Complete Exposure Pathways
  - Identification of Generic Assessment and Measurement Endpoints
- Screening-level ecological effects characterization
  - Identification of screening ecotoxicity values (direct contact, piscivorous wildlife, food web exposure)

STEP 2: SLERA EXPOSURE ESTIMATE AND RISK CALCULATION

- Identification of screening-level exposure estimates (maximum concentrations)
- Screening level risk calculations
  - Hazard quotients (direct contact, piscivorous wildlife, food web exposure)
  - Chemicals without screening values
- Evaluation of uncertainties

→ SMDP (a)

BERA

STEP 3a: REFINEMENT OF STEP 2 SLERA EXPOSURE ESTIMATES AND RISK CALCULATIONS (BERA PROBLEM FORMULATION)

- Refinement Evaluation of Direct Toxicity Exposures and Risks for Aquatic Wildlife
- Refinement Evaluation of Water/Dietary Exposures and Risks for Piscivorous Wildlife
- Refinement Evaluation of Food Web Exposures and Risks for Terrestrial Wildlife
- Refinement of Uncertainties

→ SMDP (a)

STEP 3b: REFINEMENT OF MEASUREMENT ENDPOINTS FOR BERA (ADDITIONAL PROBLEM FORMULATION)

- Refinment of risk assessment approaches for appropriate media and receptors.

→ SMDP and Technical Memorandum

STEP 4: STUDY DESIGN AND DQO PROCESS

- Study Design
- Data Quality Objectives and Statistical Considerations

→ SMDP; Draft Work Plan and Draft SAP

STEP 5: VERIFICATION OF FIELD SAMPLING DESIGN

- Determine sampling feasibility
- Final sampling location selection (including reference areas)
  (Any changes in Work Plan and Sampling and Analysis Plan agreed upon with stakeholders)

→ SMDP; Final Work Plan and Final SAP

STEP 6: SITE INVESTIGATION AND DATA ANALYSIS

- Implement Final WP and SAP (SMDP needed only if alterations in WP and SAP are necessary)

→ SMDP

STEP 7: RISK CHARACTERIZATION

- Analysis of data collected in Step 6 using the methods developed in Step 4

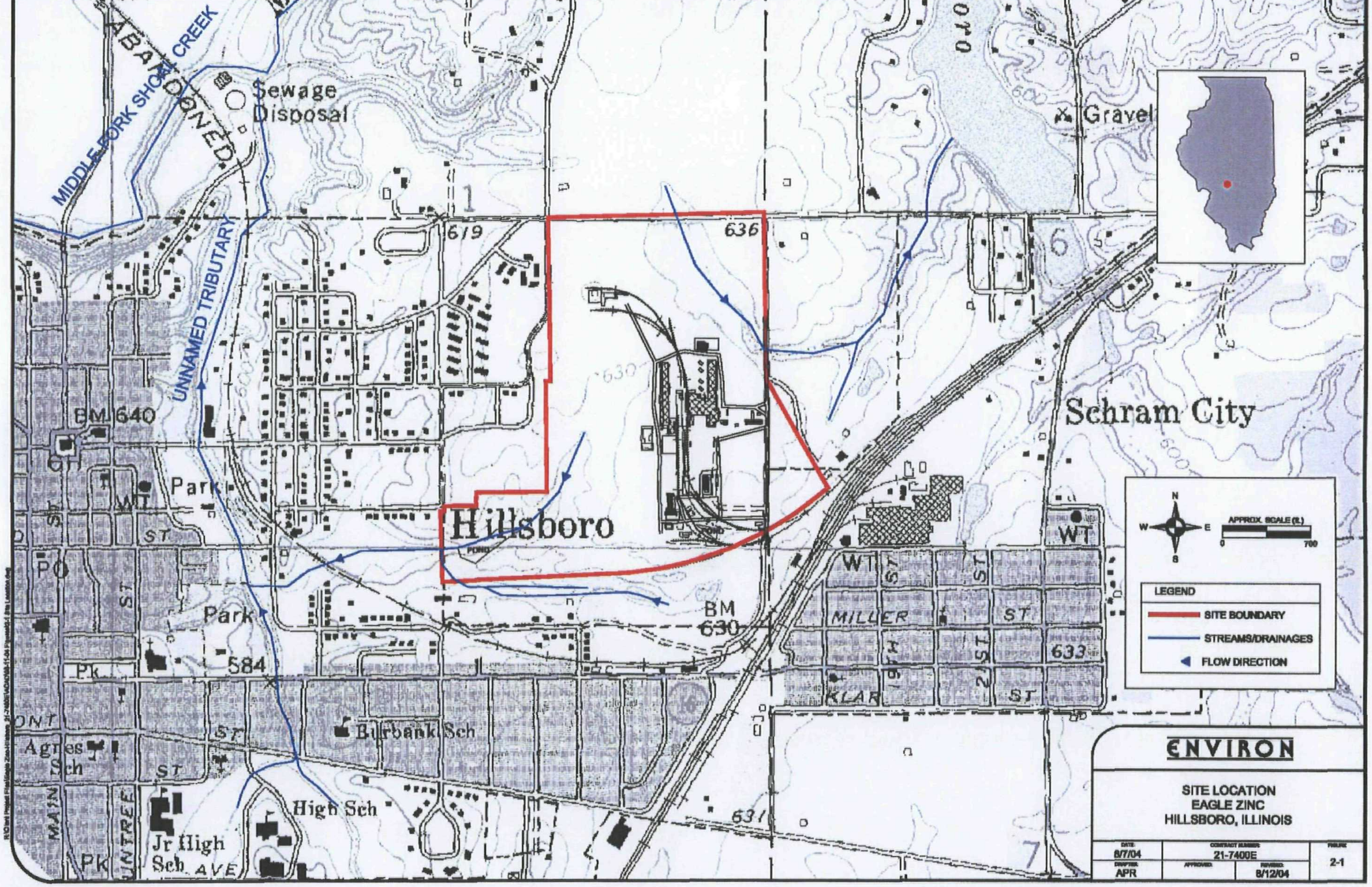
STEP 8: RISK MANAGEMENT

→ SMDP; ERA Report

Notes:

(a)	SMDP occurs EITHER after Step 2 or after Step 3a.	SMDP	Scientific Management Decision Point.
COPCs	Constituents of Potential Concern.	SW/SD	Surface water and sediment.
DQO	Data Quality Objectives.	WP	Work Plan.
GW	Groundwater.	BERA	Baseline ERA.
SAP	Sampling and Analysis Plan.	SLERA	Screening-level ERA.

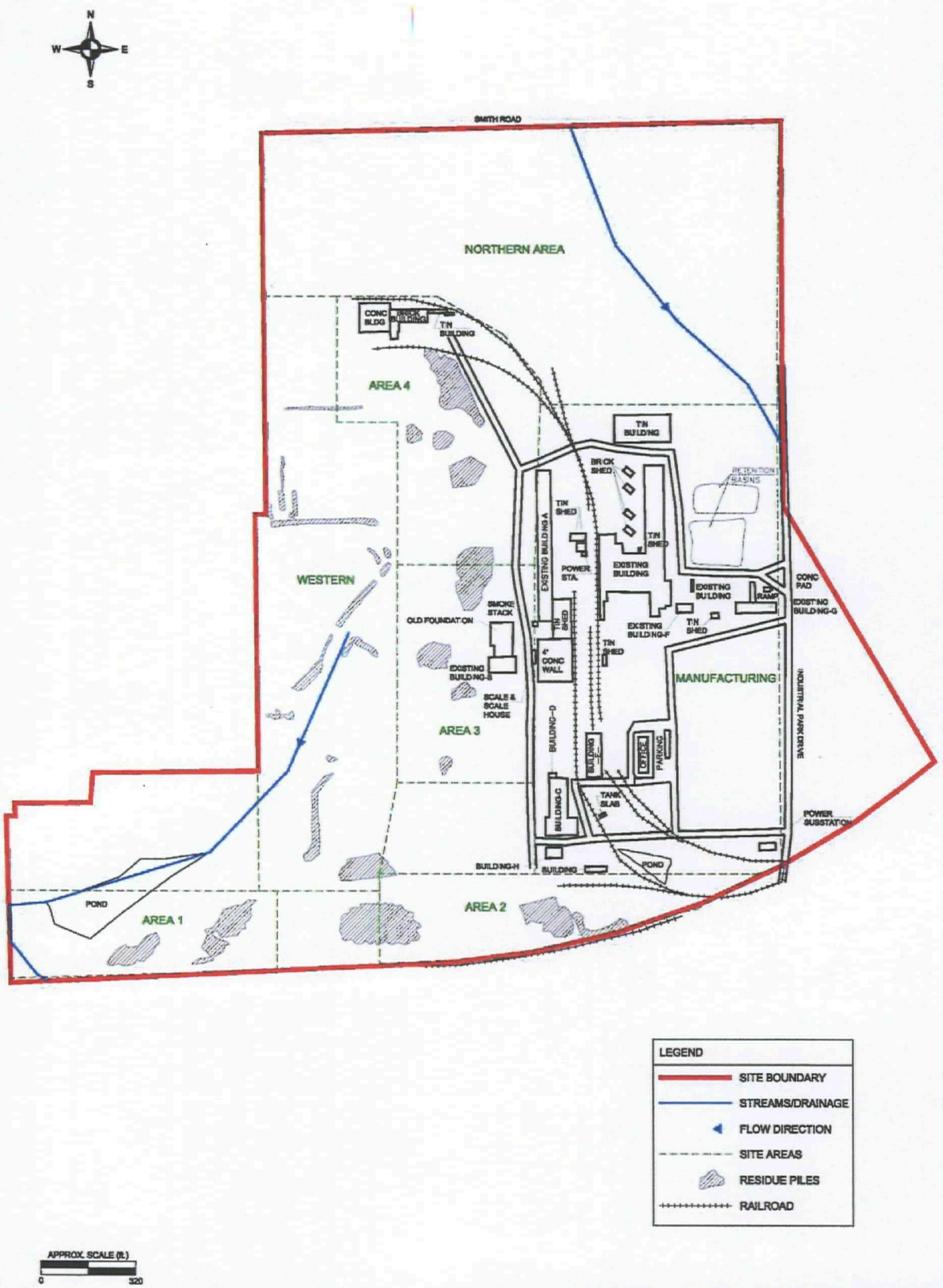
Source: Adapted from USEPA, 1997 and 2000a.



ENVIRON

SITE LOCATION
EAGLE ZINC
HILLSBORO, ILLINOIS

DATE:	CONTRACT NUMBER:	FIGURE:
6/7/04	21-7400E	2-1
DRAFTER: APR	APPROVED:	REVISED: 8/12/04



ENVIRON	SITE LAYOUT EAGLE ZINC HILLSBORO, ILLINOIS	Figure 2-2

Drafter: APR Date: 8/6/04 Contract Number: 21-7400E APPROVED: REVISED:

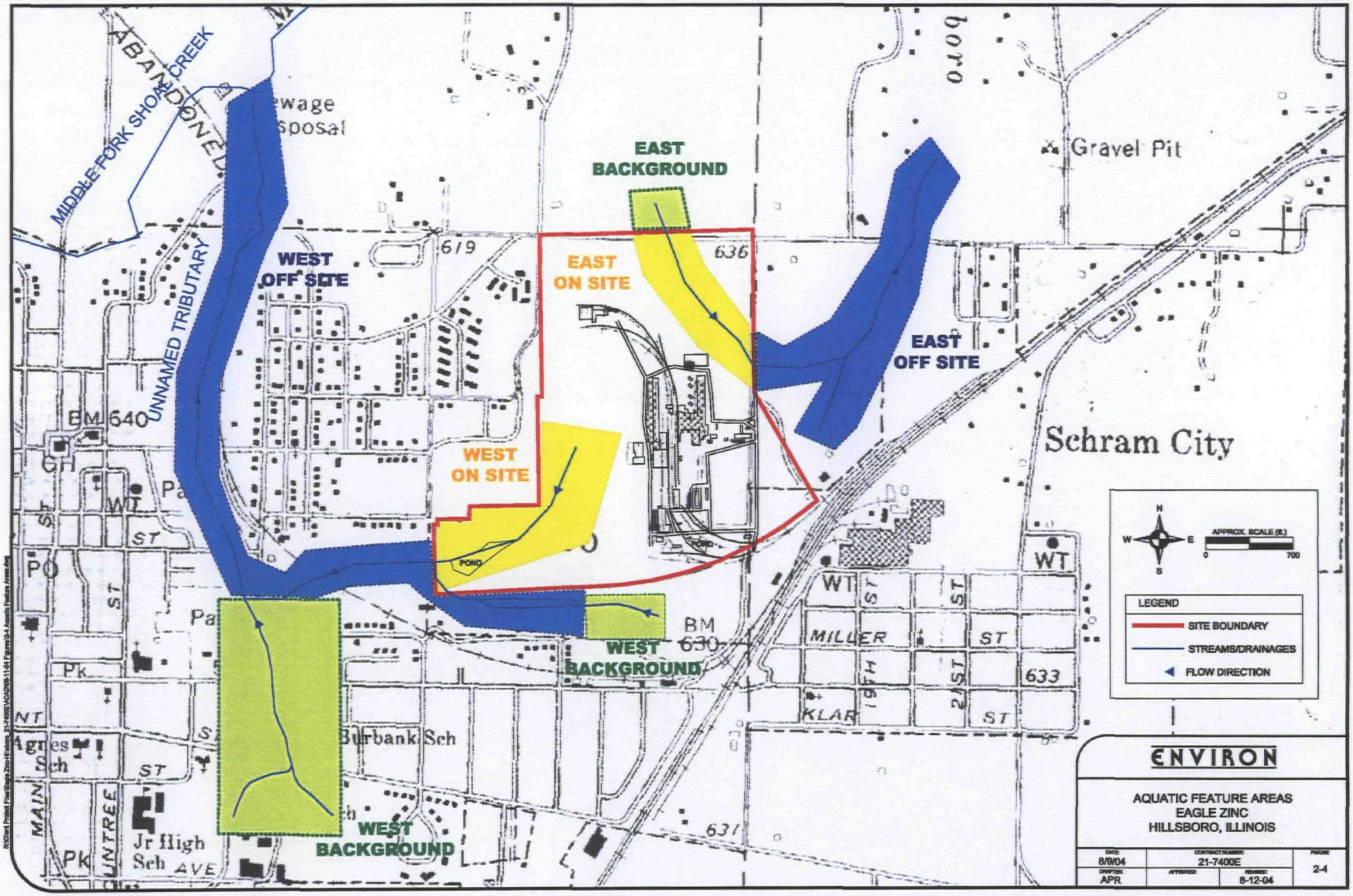
ENVIRON

SITE KEY FEATURES AND HABITATS
EAGLE ZINC
HILLSBORO, ILLINOIS

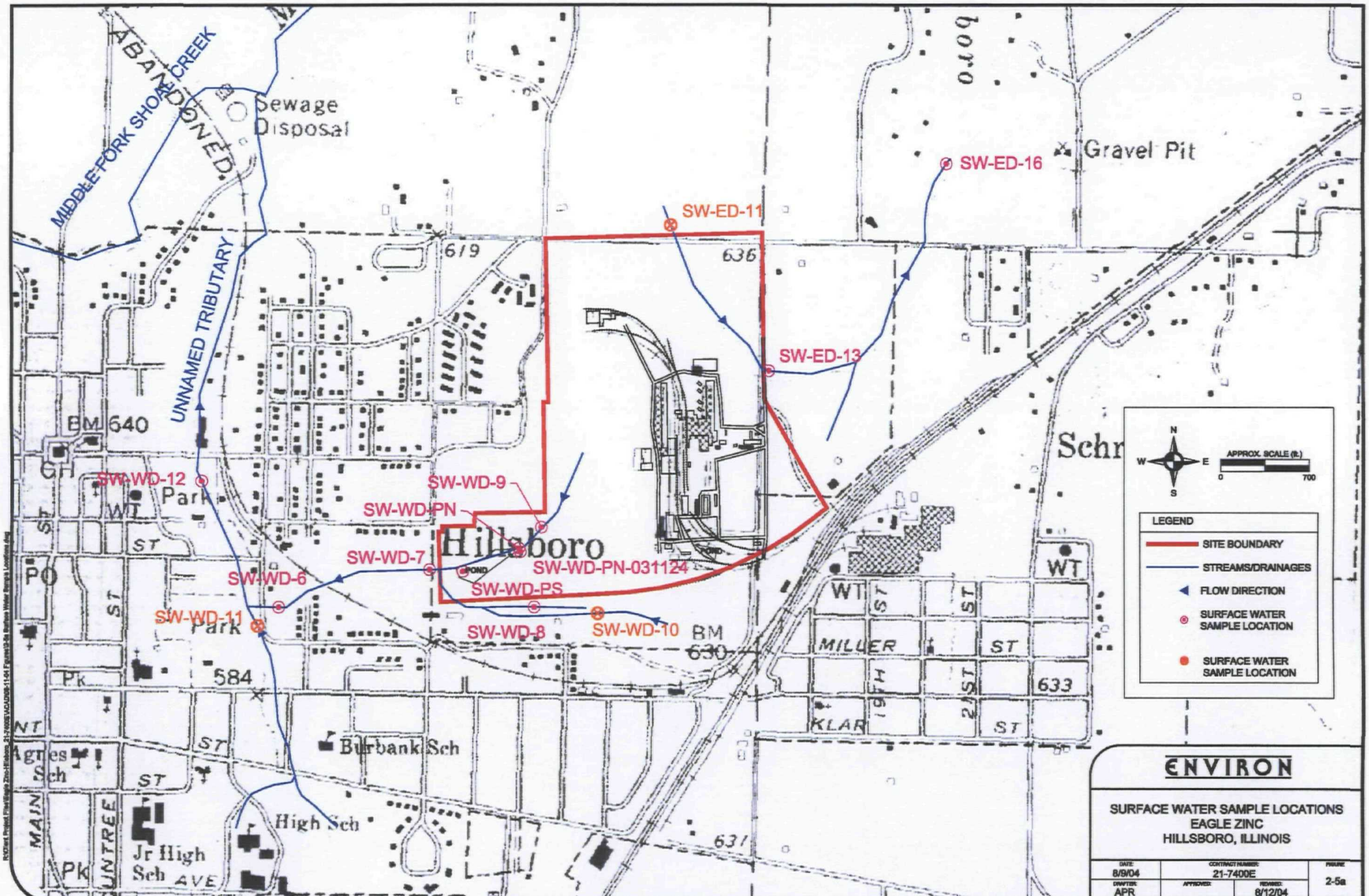
Figure
2-3

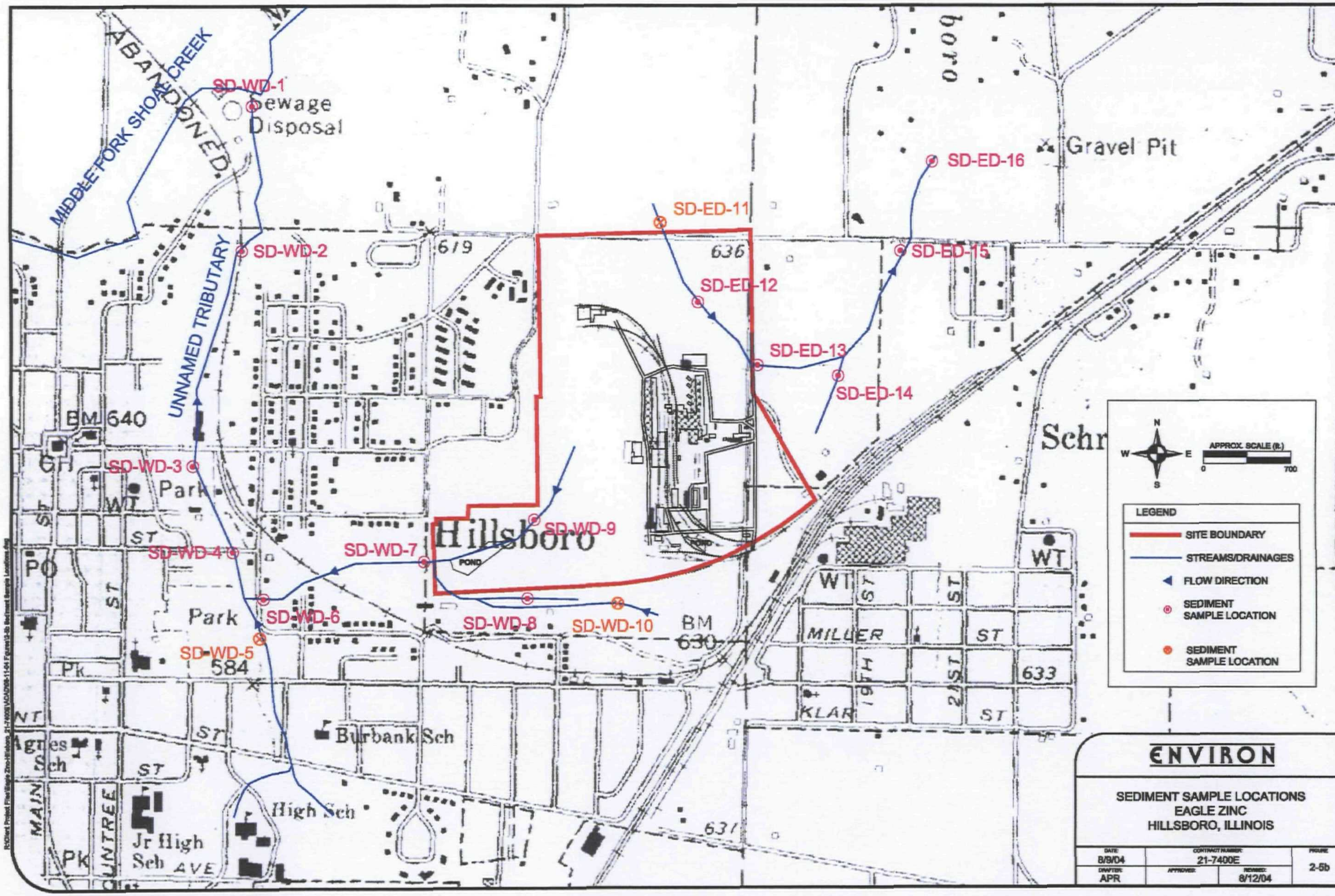
Drafter: APR | Date: 8/8/04 | Contract Number: 21-7400E | Approved: | Revised:

R:\Client Project Files\Eagle Zinc-Hillsboro 21-7400E\ACAD\080804 Figures\Site Key Features and Habitats.dwg

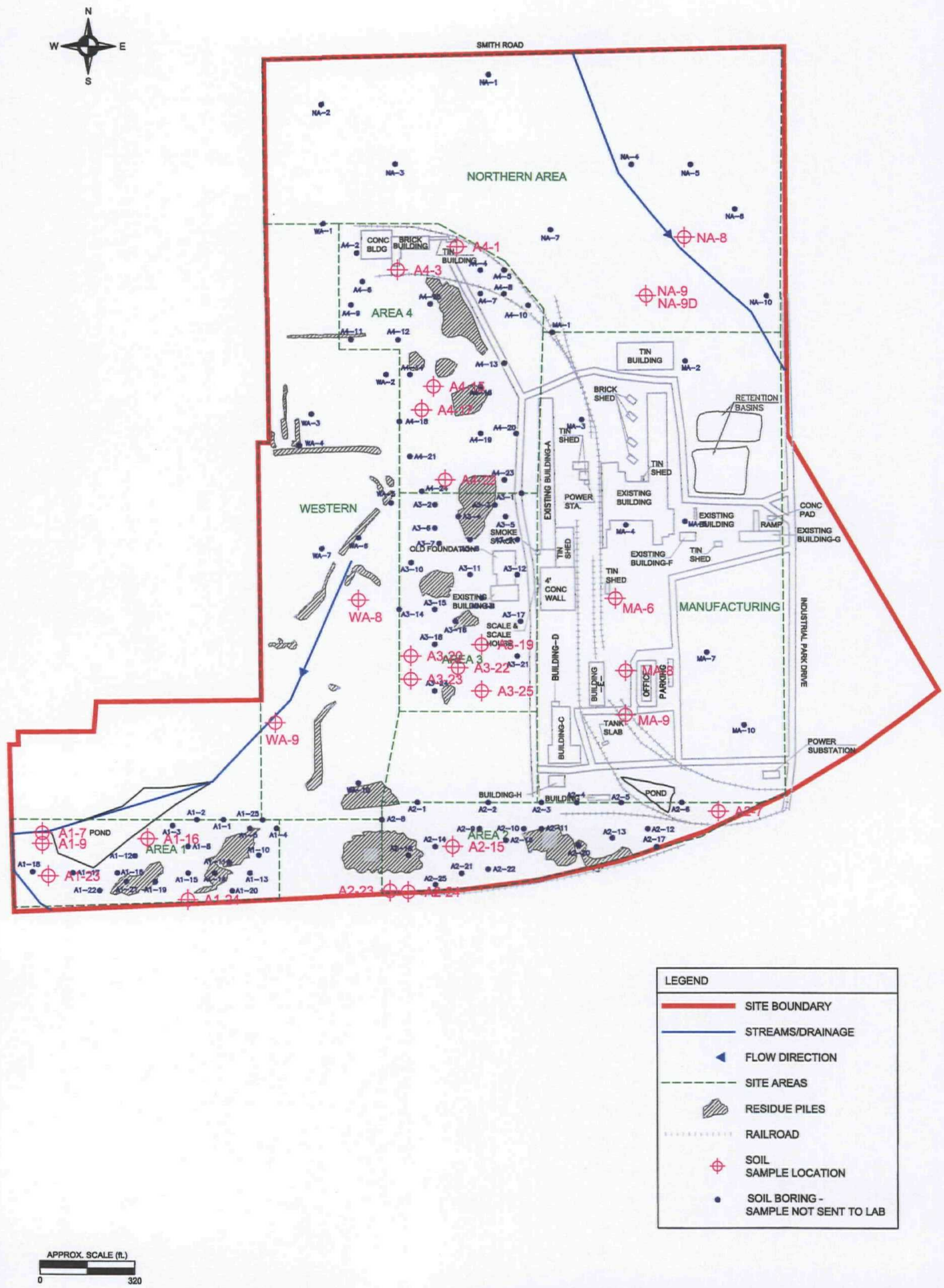


MIDDLE FORK SHOAL CREEK
ABANDONED
UNNAMED TRIBUTARY
WEST OFF SITE
EAST BACKGROUND
EAST ON SITE
EAST OFF SITE
WEST ON SITE
POND
WEST BACKGROUND
WEST BACKGROUND
Gravel Pit
Schram City
Burbank Sch
Jr High Sch
Agnes Sch
LEGEND
SITE BOUNDARY
STREAMS/DRAINAGES
FLOW DIRECTION
APPROX. SCALE (ft.)
0
700
N
S
E
W
ENVIRON
AQUATIC FEATURE AREAS
EAGLE ZINC
HILLSBORO, ILLINOIS
8/9/04
21-7400E
APR
8-12-04
2-4


Sewage Disposal
ABANDONED
MIDDLE FORK SHOAL CREEK
UNNAMED TRIBUTARY
Gravel Pit
SW-ED-16
SW-ED-11
619
636
SW-ED-13
Schr
BM 640
CH
SW-WD-12
Park
WT
ST
PO
SW-WD-9
SW-WD-PN
Hillsboro
SW-WD-7
POND
SW-WD-PN-031124
SW-WD-6
SW-WD-PS
SW-WD-11
Park
SW-WD-8
SW-WD-10
BM 630
WT
MILLER
ST
19TH ST
21ST ST
633
KLAR
ST
WT
584
Pk
Burbank Sch
Agnes Sch
ST
High Sch
Jr High Sch AVE
MAIN
UNTREE
Pk
631
N
S
E
W
APPROX. SCALE (ft.)
0
700
LEGEND
SITE BOUNDARY
STREAMS/DRAINAGES
FLOW DIRECTION
SURFACE WATER SAMPLE LOCATION
SURFACE WATER SAMPLE LOCATION
ENVIRON
SURFACE WATER SAMPLE LOCATIONS
EAGLE ZINC
HILLSBORO, ILLINOIS
DATE: 8/9/04
CONTRACT NUMBER: 21-7400E
FIGURE: 2-5a
DRAFTER: APR
APPROVED:
REVISED: 8/12/04



MIDDLE FORK SHOAL CREEK
ABANDONED
UNNAMED TRIBUTARY
SD-WD-1
Sewage Disposal
SD-WD-2
SD-WD-3
SD-WD-4
SD-WD-5
SD-WD-6
SD-WD-7
SD-WD-8
SD-WD-9
SD-WD-10
SD-ED-11
SD-ED-12
SD-ED-13
SD-ED-14
SD-ED-15
SD-ED-16
Gravel Pit
Hillsboro
POND
Park
Burbank Sch
High Sch
Jr High Sch
BM 640
BM 630
619
636
584
633
631
MILLER
KLAR
MAIN
ST
AVE
Schr
N
S
E
W
APPROX. SCALE (ft.)
0
700
LEGEND
SITE BOUNDARY
STREAMS/DRAINAGES
FLOW DIRECTION
SEDIMENT SAMPLE LOCATION
SEDIMENT SAMPLE LOCATION
ENVIRON
SEDIMENT SAMPLE LOCATIONS
EAGLE ZINC
HILLSBORO, ILLINOIS
DATE: 8/9/04
CONTRACT NUMBER: 21-7400E
FIGURE: 2-5b
DRAFTER: APR
APPROVED:
REVISED: 8/12/04

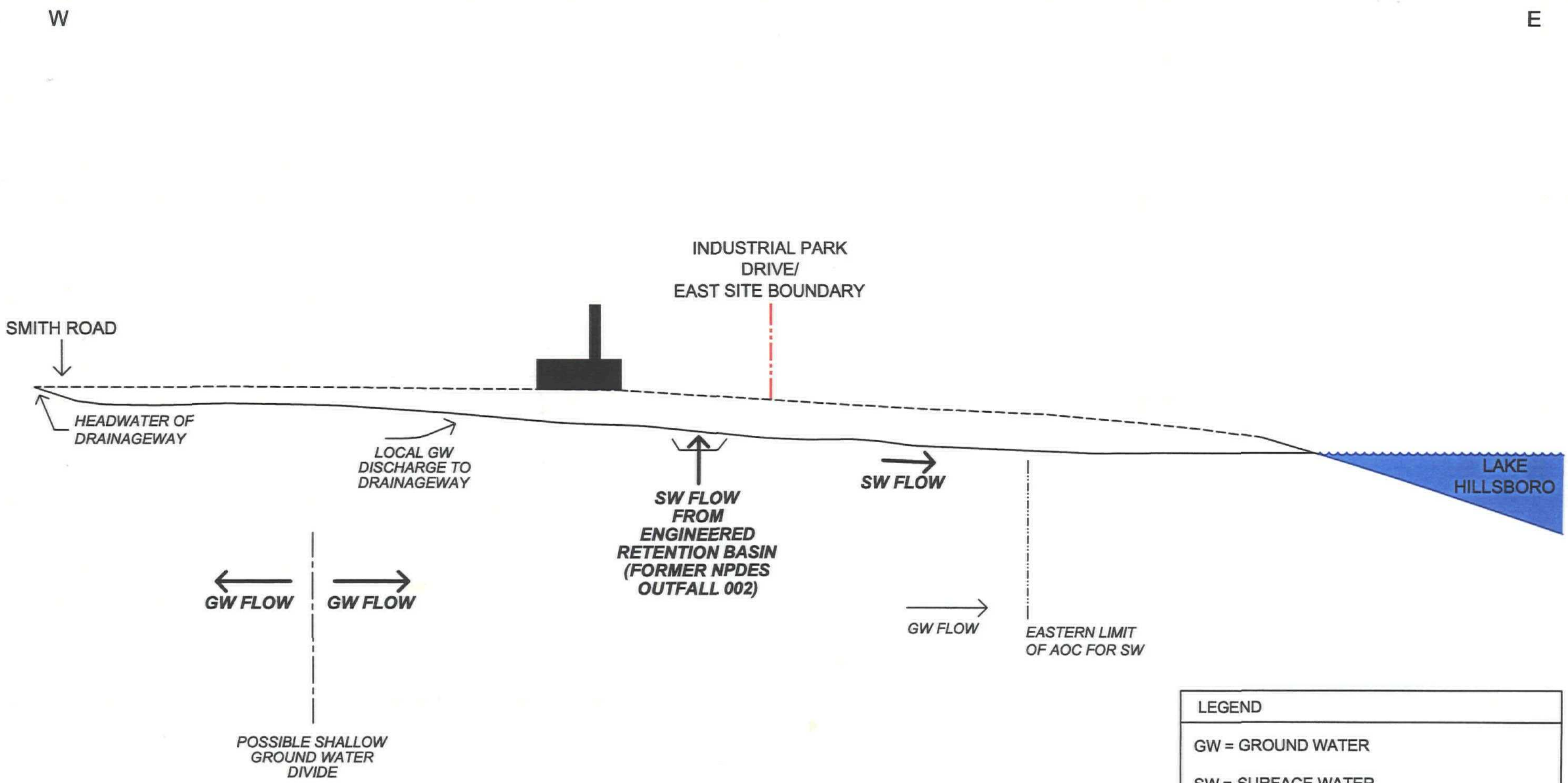


ENVIRON

SOIL SAMPLE LOCATIONS
EAGLE ZINC
HILLSBORO, ILLINOIS

Figure
2-5c

Drafter: APR Date: 8/9/04 Contract Number: 21-7400E APPROVED: REVISED: 8/12/04



LEGEND

GW = GROUND WATER

SW = SURFACE WATER

AOC = APPROXIMATE AREA OF CONCERN AS DEPICTED IN PHASE 2 TECHNICAL MEMORANDUM

---- LAND SURFACE OUTSIDE OF DRAINAGE CHANNEL

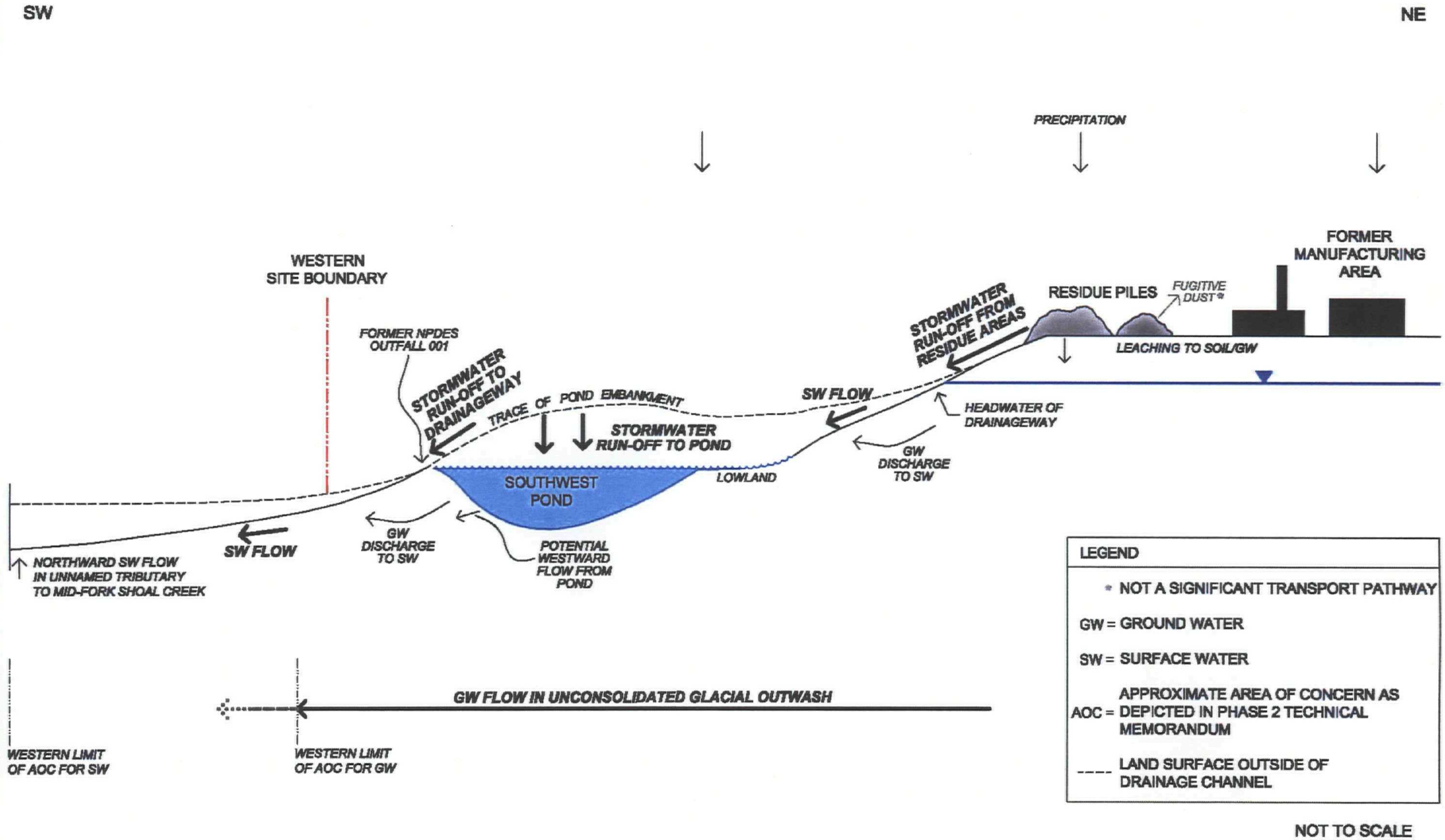
NOTE: AN AOC FOR GW WAS NOT IDENTIFIED IN THE EASTERN PORTION OF THE SITE.

NOT TO SCALE

ENVIRON	POTENTIAL TRANSPORT PATHWAYS: EASTERN DRAINAGE EAGLE ZINC HILLSBORO, ILLINOIS	Figure 2-6a

Drafter: APR | Date: 8/9/04 | Contract Number: 21-7400E | Approved: | Revised:

R:\Client Project Files\Eagle Zinc-Hillsboro_21-7400E \ACAD\08-11-04 Figures\2-6a&2-6b PTPs-E&W Drainage.dwg



NOT TO SCALE

ENVIRON

POTENTIAL TRANSPORT PATHWAYS: WESTERN DRAINAGE
EAGLE ZINC
HILLSBORO, ILLINOIS

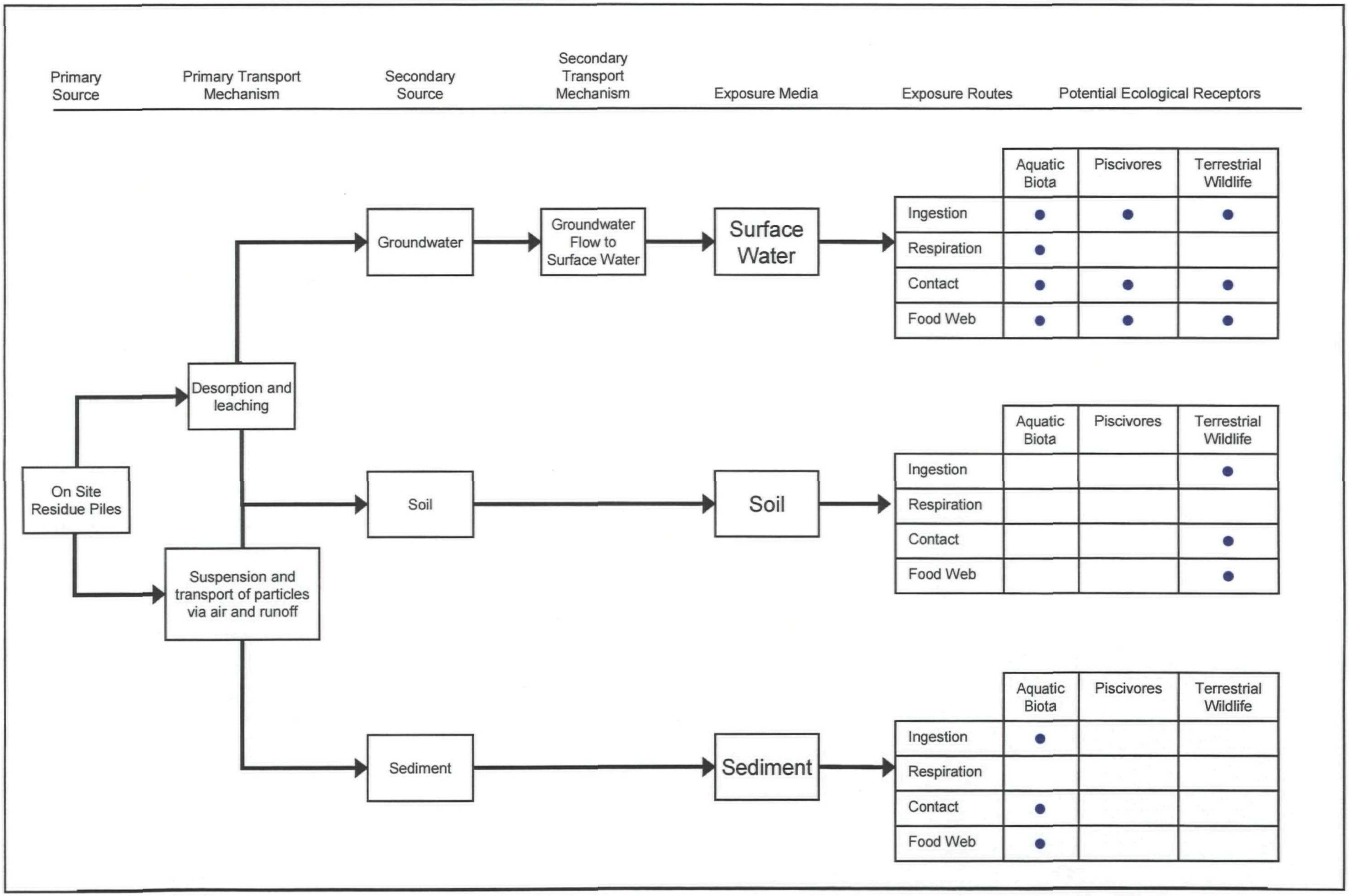
Figure 2-6b

Drafter:	APR	Date:	8/9/04	Contract Number:	21-7400E	Approved:	Revised:

R:\Client Project Files\Eagle Zinc-Hillsboro 21-7400E\ACAD\080804 Figures\PTP-EW Drainage.dwg

ENVIRON

Figure 2-7
Conceptual Site Model
Eagle Zinc
Hillsboro, Illinois



APPENDIX A

APPENDIX A

ECOLOGICAL CHARACTERIZATION INFORMATION

Appendix A-1

Check Sheet for Ecological Description of Eagle Zinc Site

Based on July 2002 Site Visit

Setting

1. What are the land uses/facilities in the vicinity of the site?

General area is characterized by intensive land use with many industrial facilities, as follows:

North small facility, Hayes Abrasives; golf course; farm fields

South small commercial/industrial facilities (Univ. of IL Extension office; Fuller Brothers Construction/Ready Mix; Hixson Lumber; Hillsboro Rental; Vogel Plumbing

East Industrial Drive; an asphalt company; a railroad corridor; former Hillsboro Glass Company facility (now a steel warehouse)

West Some undeveloped land and a residential area containing single- and multi-family dwellings

What directions do contaminant gradients follow?

Surface water, sediment, soil: Drainageways drain to southwest and northeast, following site topography (see map)

Ground water: Ground water flows generally follows topography, with flow generally towards the southwest in the western part of the site and towards the east and southeast in the eastern part of the site. Limited radial flow in northward direction.

2. What is the site's highest elevation? 637 feet

What is the site's lowest elevation? 600 feet

3. Is the site readily accessible? __X__ Yes _____ No

If No, explain: ____

4. For each pair of descriptors, circle the one that best describes the site.

Wooded/open hilly/flat marshy/dry

Other

5. Does the site contain or drain into surface water? Yes No

Site drains to Lake Hillsboro (to the east) and to a tributary of the Middle Fork Shoal Creek (to the west)

If Yes what type(s)?

Pond or lake: Artificial storm water pond

Location southwest corner of site

Area 1.2 acres

Average Depth (or depth range) unknown

Pond or lake: Artificial storm water pond

Location southeast portion of site

Area 0.27 acres

Average Depth (or depth range) unknown

Pond or lake: Artificial storm water retention basin

Location eastern portion of site (northern pond)

Area 0.41 acres (when full); surface area of water reduced by approx. 20% at time of site visit

Average Depth (or depth range) less than one foot at time of site visit

Pond or lake: Artificial storm water retention basin

Location eastern portion of site (southern pond)

Area 0.41 acres (when full); surface area of water was reduced by approx. half at time of site visit

Average Depth (or depth range) less than one foot at time of site visit

Stream or River (including intermittent streams): There are two intermittent drainage ditches on the site and two intermittent streams located offsite. These serve as storm water conduits from the site.

Onsite – The intermittent drainage ditch that crosses northeast corner of the site and flows eastward was dry at the time of the site visit.

Location Northeast corner of the site

Length (onsite) is 1,344 feet

Average Width (or width range) Dry at time of site visit

Average Depth (or depth range) Dry at time of site visit

Type(s) of bottom Silty clay

Flow Rate Dry at time of site visit

Onsite – The intermittent drainage ditch that drains the southwest portion of the site and flows west was dry at the time of the site visit.

Location Southwest portion of the site

Length (onsite) is 900 feet

Average Width (or width range) Dry at time of site visit

Average Depth (or depth range) Dry at time of site visit

Type(s) of bottom Silty clay

Flow Rate Dry at time of site visit

Offsite – The intermittent stream that begins at the outfall from the stormwater retention basins and ends at Lake Hillsboro.

Location East of the site

Length 2,724 feet

Average Width (or width range) Mostly dry at time of site visit. Channel width averages 4 feet.

Average Depth (or depth range) Mostly dry at time of site visit. Pools of water observed were approximately

10 inches deep on average.

Type(s) of bottom Silty clay, some rocks

Flow Rate Not flowing at time of visit. Water was observed in pools. Sediments were firmly dry at location of outlet to Lake Hillsboro.

Offsite – The intermittent stream that begins at the western site boundary, downstream from the southwest pond, and which ends at the unnamed tributary to Middle Fork Shoal Creek.

Location West of the site

Length 1,784 feet

Average Width (or width range) Channel width averages 3 feet.

Average Depth (or depth range) ≤ 6 inches

Type(s) of bottom Silty clay, some rocks

Flow Rate Very low flow, almost stagnant

Estuary/embayment: Not applicable

Location ______

Area ______

Average Depth (or depth range) ______

Type(s) of bottom ______

List any known parameters of site-associated surface water: On-site drainageways are ephemeral and were dry at the time of the site visit

PH ______ Temperature ______ Dissolved Oxygen ______

Total Suspended Solids ______

Total Organic Carbon ______

Hardness ______

Salinity ______

Other (specify) ______

List any known parameters of site-associated surface water: Offsite - The intermittent stream that begins at the outfall from the stormwater retention basins and ends at Lake Hillsboro. Measurements taken from pool of water (stream was mostly dry) ~150 meters downstream of Industrial Drive

PH ______ Temperature 21.5 °C Dissolved Oxygen ______

Total Suspended Solids ______

Total Organic Carbon ______

Hardness ______

Salinity ______

Other (specify) Conductivity 543 μS/cm

List any known parameters of site-associated surface water: Offsite – The intermittent stream that begins at the western site boundary, downstream from the southwest pond, and which ends at the unnamed tributary to Middle Fork Shoal Creek. Measurements taken just downstream of site.

PH ______ Temperature 15.8 °C Dissolved Oxygen_______

Total Suspended Solids______________________

Total Organic Carbon ______________________

Hardness ______________________________

Salinity ________________________________

Other (specify) Conductivity 933 µS/cm, Iron color and some precipitate observed in stream just downstream of the pond. Sedimentation problems apparent, cement tailings from nearby cement facility spilled over the bank and appear to be contributing to sedimentation problems.

List any known sediment parameters of site-associated bodies of surface water:

Sediment type(s)

Grain Size _______ pH _____ Eh _____ pE_____

Total Organic Carbon

Acid-Volatile Sulfides

Other (specify):

(If more than one surface water body of each type, repeat information as needed.)

6. Does the site contain or drain into wetlands? X Yes _____No

If Yes, what type(s) and size(s)? According to the National Wetland Inventory (NWI) Map for Hillsboro, Illinois (U.S. Fish and Wildlife Service, 1988), the only mapped wetlands on the site property include the southwest retention pond and the small pond located in the southeast part of the site. These ponds are mapped as "intermittently exposed palustrine wetlands with unconsolidated materials in diked or impounded areas."

List any known surface water and sediment parameters of site wetlands, as in #5, above.
See #5 above (ponds)

7. Describe sub-surface hydrology.

Overlying strata None

Aquifer Unconfined water table aquifer composed of stratified glacial deposits ranging from silty clay to clayey sand

Depth of aquifer Unknown

Location of groundwater discharge Eastern drainageway, western drainageway

Appendix A-1

Ecological Description

8. List and describe habitats that occur at the site.

Habitats are physically impacted by past, current and anticipated future industrial uses.

Woodlands Deciduous woods (see map)

Grasslands/open fields grasslands and open fields (see map)

Wetlands See stormwater pond locations

Ponds Southwest corner of site – retention pond; Southeast corner of site – retention pond; Northeast corner of site – 2 retention basins.

Streams Intermittent drainageways draining northeast and southwest portions of the site. Onsite drainageways dry during site visit.

Estuaries N/A

Coastal zones N/A

Flood plains N/A

Other natural areas N/A

List any known soil and sediment parameters for each terrestrial habitat.

Soil type(s)

Grain Size________ pH ______ Eh ______ pE______

Total Organic Carbon

Total Phosphorus

Nitrogen forms

Other

9. Are any Federally or State listed endangered or threatened species known or suspected to occur on or near the site?

__________Yes __X__ No

Site visit and database search indicated no threatened or endangered species on or near the site (see attached correspondence).

If yes, list:

10. Does the site have any game specie s or species of interest for another reason? _X_Yes_____No

If yes, list:

Deer tracks observed, common in area.

Known Ecological Effects

11. Does the site show any evidence of adverse ecological effects? X___ Yes______ No

If yes, list:

Intensive land use during past industrial activities has resulted in physical disturbances to habitats and resultant adverse ecological effects. Manufacturing areas and waste pile areas were cleared of trees, and soils were disturbed for industrial use, resulting in loss of habitat and surface runoff. Some adverse impacts were observed on some remaining trees; dead trees in northern part of site may be due to poor drainage. Sedimentation of nearfield offsite drainageways in the SW drainage has suppressed benthic life. Contributions to sedimentation from a nearby cement plant were apparent. Nearby reference sites had freshwater mussels and clams not observed in this area.

12. Documentation attached:

X___Site Map

X___Species List

X___Threatened and Endangered Species Correspondence

Species or Sign Observed During Site Visits[a]
Eagle Zinc Company Site

Animals	Plants
• Common shiner • Crayfish • Damselfly • Dragonfly • Fathead minnow • Frogs • Green heron • Green sunfish • Raccoon tracks • Songbirds • Turtles, including eastern box turtle • Whitetail deer	• Carex (sedge) • Catalpa • Cottonwood • Locust • Nettles • Phragmites (common reed) • Pondweed • Sassafras • Willow
(a) Site visits conducted July 2002, March 2004, June 2004	

Appendix A-3

List of Sensitive Habitats in the Hazard Ranking System[a]

- Critical habitat for Federal designated endangered or threatened species
- Marine Sanctuary
- National Park
- Designated Federal Wilderness Area
- Areas identified under the Coastal Zone Management Act
- Sensitive areas identified under the National Estuary Program or Near Coastal Waters Program
- Critical areas identified under the Clean Lakes Program
- National Monument
- National Seashore Recreational Area
- National Lakeshore Recreational Area
- Habitat known to be used by Federal designated or proposed endangered or threatened species
- National Preserve
- National or State Wildlife Refuge
- Unit of Coastal Barrier Resources System
- Coastal Barrier (undeveloped)
- Federal land designated for protection of natural ecosystems
- Administratively Proposed Federal Wilderness Area
- Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or
- coastal tidal waters
- Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time
- Terrestrial areas utilized for breeding by large or dense aggregations of animals
- National river reach designated as Recreational
- Habitat known to be used by state designated endangered or threatened species
- Habitat known to be used by species under review as to its Federal endangered or threatened status
- Coastal Barrier (partially developed)
- Federally-designated Scenic or Wild River
- State land designated for wildlife or game management
- State-designated Scenic or Wild River
- State-designated Natural Areas
- Particular areas, relatively small in size, important to maintenance of unique biotic communities
- State-designated areas for protection or maintenance of aquatic life
- Wetlands

[a] From USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Solid Waste and Emergency Response. EPA 540-R-97-006.

Appendix A-4

-----Original Message-----
From: TARA KIENINGER [mailto:TKIENINGER@dnrmail.state.il.us]
Sent: Monday, October 20, 2003 2:37 PM
To: Penelope Moskus
Subject: Re: Request for threatened and endangered species search

October 20, 2003

Penelope Moskus
Limno-Tech, Inc.
501 Avis Drive
Ann Arbor, MI 48108

Dear Ms. Moskus:

I have reviewed the information you provided via email today regarding the Eagle Zinc Company Site near Hillsboro, Illinois. According to the Illinois Natural Heritage Database, there are no endangered or threatened species within the site area you indicated, specifically Township 8 North, Range 4 West, Sections 1 & 12, Third Principal Meridian. Nor are there any listed species within 1 mile of the project site boundaries.

Please be aware that the Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of significant natural features in Illinois. The Department of Natural Resources and the Illinois Nature Preserves Commission can only summarize the existing information known to us at the time of the request. This report should not be regarded as a final statement on the area being considered, nor should it substitute for field surveys required for environmental assessments.

This letter is separate from the Illinois Department of Natural Resources consultation requirement under the Illinois Endangered Species Act (530 ILCS 10/11) and the Illinois Natural Areas Preservation Act (525 ILCS 30/17). For more information on this process, please contact the Illinois Department of Natural Resources, Division of Resource Review and Coordination, at One Natural Resources Way, Springfield, Illinois 62702-1271 or by telephone at (217)785-5500.

Tara Gibbs Kieninger, Database Administrator
Illinois Natural Heritage Database
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271
tkieninger@dnrmail.state.il.us
217.782.2685
217.785.2438 (fax)

A-5a: Abandoned buildings and manufacturing areas – July 2002.

A-5b: Residue piles in open areas of Site, looking northwest – March 2004.

A-5c: Abandoned manufacturing area – June 2004.

A-5d: Manufacturing area showing dead catalpas – March 2004.

A-5e: Inundated area with dead and living trees on Site, north of the manufacturing area – June 2004.

A-5f: Inundated area with dead catalpa trees, among living willow trees on Site, north of manufacturing area (within the Eastern Drainage) – June 2004.

A-5g: Inundated area on Site with dead or dying catalpa trees, north of manufacturing area (within the Eastern Drainage) – June 2004.

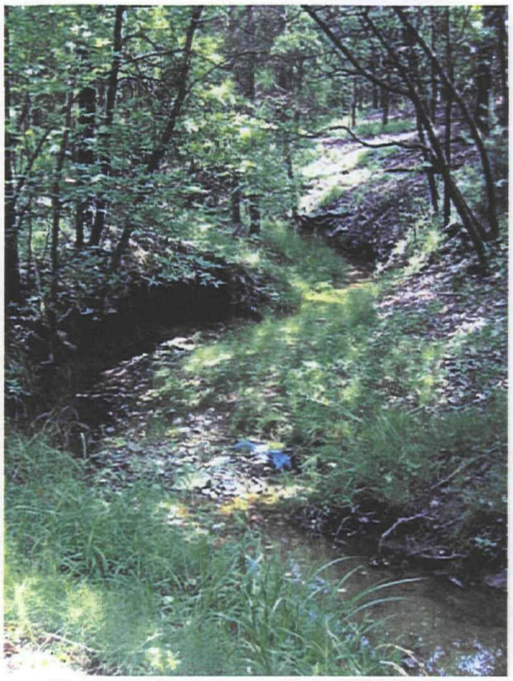
A-5h: Living willow trees, among dead catalpa trees, in flooded area on Site, north of manufacturing area – June 2004.

A-5i: Dead catalpa, among living trees, in flooded area in the extreme northern portion of the Site, away from source areas, – June 2004.

A-5j: Catalpa sapling growing from a slag pile – June 2004.

A-5k: Old field in northern portion of Site – March 2004.

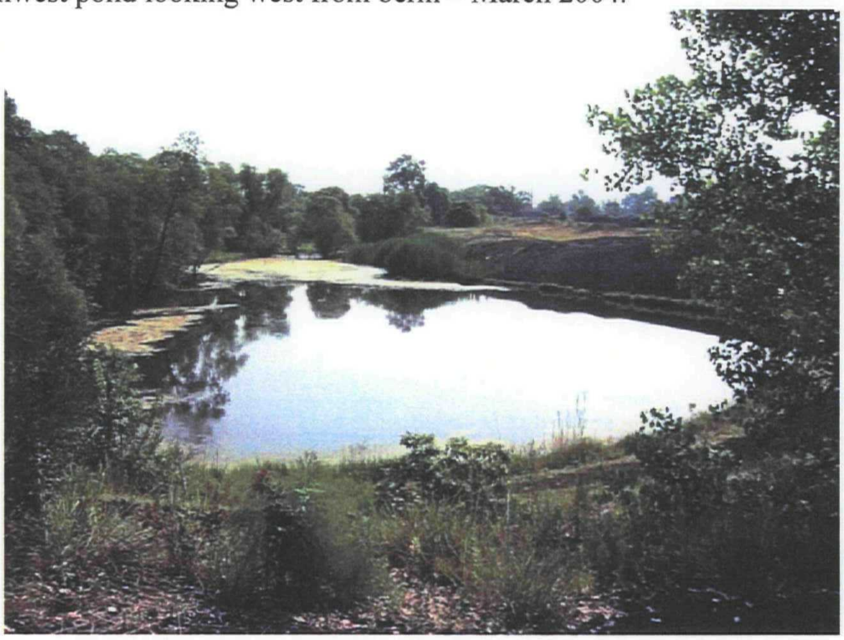
A-5l: Northern old field – June 2004.




A-5m: Eastern drainage – July 2002; June 2004.

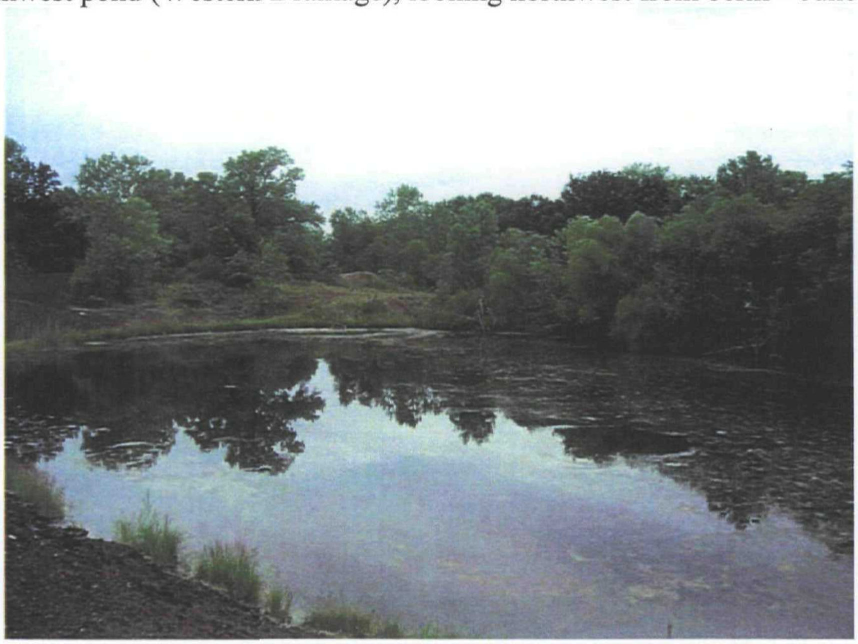
A-5n: View across Lake Hillsboro with location of eastern drainage inflow at center opposite – July 2002.

A-5o: Southwest pond looking west from berm – March 2004.



A-5p: Pond in southwest portion of Site, looking northeast up the basin – July 2002.

A-5q: Southwest pond (Western Drainage), looking northwest from berm – June 2004.



A-5r: Southwest pond (Western Drainage), oriented approximately west from berm – June 2004.

A-5s: Southwest pond (Western Drainage), with view of southern berm – June 2004.

A-5t: Outflow from southwestern pond (Western Drainage) – June 2004.

A-5u: Western Drainage, on Site, upgradient of the southwestern pond – June 2004.

A-5v: Western drainage below confluence with south drainage – March 2004.

A-5w: Western Drainage, upstream from southwestern pond outfall – June 2004.

A-5x: Off Site Western Drainage through residential area – June 2004.

A-5y: Off Site Western Drainage through park – June 2004.

A-z: Adult green sunfish in southwest pond – July 2002.

A-5aa: Turtle in floodplain of western drainage – July 2002.

A-5bb: Frog in floodplain of western drainage – July 2002.

APPENDIX B

DATA USED IN THE ECOLOGICAL RISK ASSESSMENT AND BACKGROUND DATA

Table B-1
Surface Water Data
Eagle Zinc
Hillsboro, Illinois

Constituent	CAS Number	SW-WD-9 On Site 03/10/03	SW-WD-PN On Site 03/10/03	SW-WD-PS On Site 03/10/03	SW-ED-13 Off Site 03/10/03	SW-ED-16 Off Site 03/10/03	SW-WD-6a Off Site 03/10/03	SW-WD-6b Off Site 06/13/03	SW-WD-6bd Off Site 06/13/03	SW-WD-12 Off Site 06/13/03	SW-WD-7 Off Site 03/10/03	SW-WD-7D Off Site 03/10/03	SW-WD-8 Off Site 03/10/03
Inorganics (mg/L)													
Aluminum	7429905	<0 027	0 037	<0 027	0 031	0 13	0 047	<0 076	<0 055	1 4	<0 027	<0 027	<0 027
Antimony	7440360	<0 0025	<0 0025	<0 0025	<0 0025	<0 0025	<0 0025	0 0003	0 00026	0 00032	<0 0025	<0 0025	<0 0025
Arsenic	7440382	<0 0081	<0 0081	<0 0081	<0 0081	<0 0081	<0 0081	0 0012	0 0012	0 0022	<0 0081	<0 0081	<0 0081
Barium	7440393	0 024	0 041	0 04	0 071	0 05	0 036	0 047	0 05	0 089	0 021	0 021	0 041
Beryllium	7440417	<0 00061	<0 00061	<0 00061	<0 00061	<0 00061	<0 00061	<0 0001	<0 00011	0 00018	<0 00061	<0 00061	<0 00061
Cadmium	7440439	0 23	0 087	0 069	0 0071	<0 00053	0 019	0 0058	0 0089	0 0012	0 034	0 034	0 0023
Calcium	7440702	120	120	110	80	42	150	90	86	51	140	140	130
Chromium	7440473	<0 00093	<0 00093	<0 00093	<0 00093	0 0011	<0 00093	0 00061	0 00062	0 0018	<0 00093	<0 00093	<0 00093
Cobalt	7440484	<0 0009	0 0024	0 0019	<0.0009	<0 0009	0 0016	0 00088	0 00084	0 0009	<0 0009	<0 0009	0 00092
Copper	7440508	0 0026	0 0023	0 0017	0 004	0 002	0 0016	0 0033	0 0032	0 0041	0 0049	0 0048	0 0011
Iron	7439896	0 056	0 17	0 15	0 28	0 23	0 39	0 56	0 53	1 6	0 44	0 46	3 2
Lead	7439921	<0 0013	0 0032	0 0022	<0 0013	<0 0013	<0 0013	0 0028	0 0028	0 0052	0 0023	0 0022	<0 0013
Magnesium	7439954	38	38	33	27	14	36	25	23	14	31	31	27
Manganese	7439965	0 01	0 3	0 27	0 38	0 1	0 62	0 35	0 34	0 27	0 077	0 078	0 4
Mercury	7439976	<0 000028	<0.000028	<0 000028	<0 000028	<0 000028	<0 000028	<0 0002	0 00003	<0 00002	<0.000028	<0 000028	<0 000028
Nickel	7440020	0 036	0 029	0 026	0 012	0 0018	0 012	0 0073	0 0074	0 0041	0 019	0 017	0 0029
Potassium	7440097	17	14	13	3 6	5.2	7 6	5 8	6	5 5	9 2	9 2	5 1
Selenium	7782492	<0 0048	<0 0048	<0 0048	<0 0048	<0 0048	<0 0048	0 002	0 0019	0 0014	<0 0048	<0 0048	<0 0048
Silver	7440224	<0 0011	<0 0011	<0 0011	<0 0011	<0 0011	<0 0011	0 00006	<0 000049	0 00006	<0 0011	<0 0011	<0 0011
Sodium	7440235	57	46	41	41	15	52	32	29	24	60	60	41
Sulfate	14808798	420	450	430	130	160	330	*NS*	*NS*	*NS*	260	270	210
Thallium	7440280	<0 0043	<0 0043	<0 0043	<0 0043	<0 0043	<0 0043	<0 00015	<0 00013	<0 00012	<0 0043	<0 0043	<0 0043
Vanadium	7440622	<0 00084	<0 00084	<0 00084	<0 00084	0 00087	<0 00084	0 0007	0 00065	0 0051	<0 00084	<0 00084	<0 00084
Zinc	7440666	26	16	14	11	0 84	15	4	3 6	0 71	25	26	1 2
Organics (µg/L)													
cis-1,2-Dichloroethene	156592	0 002	0 0022	*NS*	<0 00081	*NS*	*NS*	*NS*	*NS*	*NS*	<0 00081	<0 00081	*NS*
Trichloroethylene	79016	0 0063	0 0014	*NS*	<0 00039	*NS*	*NS*	*NS*	*NS*	*NS*	<0 00039	<0 00039	*NS*

Notes
NS Not sampled
< The constituent was not detected at a concentration greater than the reported detection limit
CAS Chemical abstract service
mg/L Milligrams per liter
µg/L Micrograms per liter

Table B-2
Sediment Data
Eagle Zinc
Hillsboro, Illinois

Constituent	CAS Number	SD-ED-13 SD Off 07/09/02	SD-ED-14 SD Off 07/08/02	SD-ED-15 SD Off 07/08/02	SD-ED-16 SD Off 07/08/02	SD-WD-01 SD Off 07/08/02	SD-WD-02 SD Off 07/08/02	SD-WD-03 SD Off 07/08/02	SD-WD-04 SD Off 07/08/02	SD-WD-06 SD Off 07/08/02	SD-WD-07 SD Off 07/08/02	SD-WD-08 SD Off 07/09/02	SD-ED-12 SD On 07/09/02	SD-WD-09 SD On 07/09/02	SD-WD-09d SD On 07/09/02
Inorganics (mg/kg)															
Aluminum	7429905	4900	9600	3900	6600	7700	6200	2400	2300	4200	6400	19000	6100	7500	7600
Antimony	7440360	2.3	1.8	0.84	1.9	0.52	<0.45	0.48	0.83	1.7	12	2.8	0.62	2.1	2.1
Arsenic	7440382	6.1	7.2	5.8	3.2	3.4	3.9	2.5	3.2	8	25	7	2.4	7.9	5.1
Barium	7440393	59	71	44	63	50	53	51	30	67	190	99	82	76	67
Beryllium	7440417	0.43	0.75	0.39	0.5	0.36	0.43	0.31	0.27	0.52	0.69	1.1	0.36	0.65	0.67
Cadmium	7440439	13	3.7	2.3	8.9	1.2	1.6	0.96	0.83	23	96	17	2.4	550	550
Calcium	7440702	23000	15000	6000	4100	7200	14000	8200	10000	3600	2600	2900	1300	2400	2300
Chromium	7440473	8.5	14	7.1	10	8.1	8.9	5.9	6.7	10	22	26	11	17	12
Cobalt	7440484	7.3	12	6.6	6	2.8	4	1.9	3.4	4.1	6.1	14	1.2	11	9.3
Copper	7440508	52	18	4.8	53	9.9	15	27	5.7	51	320	97	8.9	58	65
Iron	7439896	15000	19000	11000	8500	7300	9800	6900	6900	20000	45000	20000	5100	29000	19000
Lead	7439921	84	75	20	87	26	49	32	29	290	2700	450	25	220	240
Magnesium	7439954	5400	3200	3500	1800	1900	2400	1700	2700	1000	1200	2300	760	1000	1000
Manganese	7439965	340	750	740	390	230	420	190	330	380	110	360	70	230	150
Mercury	7439976	0.024	0.064	<0.0046	0.15	0.065	0.06	0.031	0.012	0.9	0.16	1.4	0.019	1.3	1.7
Nickel	7440020	15	15	7.9	17	6.7	8.9	4.7	4.2	12	27	26	4.6	29	25
Potassium	7440097	530	860	440	620	570	470	300	270	400	610	1400	660	690	730
Selenium	7782492	<0.5	<0.53	<0.44	<0.72	<0.67	<0.55	<0.56	<0.52	<0.62	1.4	<0.73	<0.53	1.1	1.1
Silver	7440224	0.39	<0.079	<0.066	0.46	<0.1	<0.09	<0.091	0.089	0.25	2.4	0.99	<0.079	0.37	0.38
Sodium	7440235	<21	<86	<40	<26	<88	<67	<79	<61	<23	<89	<27	<92	<28	<26
Vanadium	7440622	16	27	16	15	11	12	7.8	9.5	13	23	30	13	34	20
Zinc	7440666	11000	5100	530	8400	500	1400	400	520	10000	23000	7600	830	12000	9700
Organics (µg/kg)															
2-Butanone	78933	1.6*r*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	2.2*r*	*NS*	1.9*r*	8.6	20
Acetone	67641	3.2*r*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	4.7*r*	*NS*	3.9*r*	26	49
cis-1,2-Dichloroethene	156592	<1.2	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	<1.7	*NS*	<1.4	4.1	86
trans-1,2-Dichloroethene	156605	<1	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	<1.4	*NS*	<1.2	5.6	20
Trichloroethylene	79016	<1.2	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	<1.7	*NS*	<1.4	3	4.5
Vinyl Chloride	75014	<1.1	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	<1.5	*NS*	<1.3	2.5	13

Notes

NS	Not sampled
r	Data was flagged as "rejected" and was not used in this risk assessment
<	The constituent was not detected at a concentration greater than the reported detection limit
CAS	Chemical abstract service
mg/kg	Milligrams per kilogram

Table B-3
Soil Data
Eagle Zinc
Hillsboro, Illinois

Constituent	CAS Number	A1-03 RA	A1-06 RA	A1-07 RA	A1-23 RA	A1-24 RA	A2-07 RA	A2-15 RA	A2-19 RA	A2-23 RA	A2-24 RA	A3-19 RA	A3-20 RA	A3-22 RA	A3-23 RA
Inorganics (mg/kg)															
Aluminum	7429905	15,000	8,300	17,000	14,000	12,000	29,000	27,000	23,000	23,000	21,000	32,000	30,000	18,000	28,000
Antimony	7440360	0.34	<0 33	<0 71	<0.41	<0 77	0.9	0.46	1 9	<0.45	0 47	0 73	<2.0	0 86	0.72
Arsenic	7440382	3.7	1 9	4 3	6.1	5 1	12	3 9	12	4.2	4.1	13	8.3	6.8	4.8
Barium	7440393	66	46	100	50	66	210	110	140	99	76	190	140	110	120
Beryllium	7440417	0 78	0.62	1.1	0 87	0 79	1 5	1.1	1 2	0 96	0 94	1.2	1	0 79	1 1
Cadmium	7440439	5.6	87	44	56	6 1	1.6	6 8	3 8	4.2	13	19	6 3	21	7.9
Calcium	7440702	2,200	36,000	1,100	19,000	1,600	1,300	1,200	530	840	620	3,400	1,500	1,100	1,500
Chromium	7440473	20	12	21	20	16	32	28	27	27	25	37	34	24	30
Cobalt	7440484	3.9	7 1	4.4	6.4	4 5	9.5	4	6 7	3 4	3 5	6 1	5.2	6.4	3.7
Copper	7440508	11	9 1	14	14	16	23	35	17	15	11	21	21	12	15
Iron	7439896	15,000	10,000	14,000	18,000	16,000	31,000	21,000	26,000	19,000	16,000	31,000	29,000	18,000	22,000
Lead	7439921	9 1	8 2	22	8.9	19	23	23	18	11	7.4	16	11	13	10
Magnesium	7439954	3,000	22,000	2,000	12,000	1,800	3,800	2,900	3,000	2,100	1,800	4,100	4,300	2,700	2,400
Manganese	7439965	98	400	120	200	180	610	82	540	87	140	280	350	230	68
Mercury	7439976	<0.0047	0 0088	0.028	0.013	<0 0051	0 025	0 019	0 031	0.036	0.023	0.023	0.021	0.0064	0.039
Nickel	7440020	16	19	12	21	11	24	17	16	13	13	18	20	13	15
Potassium	7440097	1,900	1,800	1,400	2,300	1,900	2,400	1,800	1,600	1,300	1,200	2,400	2,200	1,500	1,700
Selenium	7782492	<0 27	<0 28	<0 58	<0 3	1 7	<0 33	<0 31	<0.35	<0 32	<0.3	<0 64	<1.4	<0.28	<0.29
Silver	7440224	<0.067	<0.067	<0 14	<0 081	<0.15	<0 089	<0.084	0 42	<0 09	<0.071	<0 086	<0.4	<0 079	<0.079
Sodium	7440235	42	61	33	39	69	81	26	28	30	20	120	71	93	34
Thallium	7440280	0.41	0 47	<0 7	0 9	<0 71	1.1	0 59	0 88	0 73	0.6	1 1	<1.7	0.49	1 3
Vanadium	7440622	28	16	39	29	24	69	46.	57	47	39	72	57	47	49
Zinc	7440666	1,100	11,000	2,800	5,700	2,000	620	1,800	2,200	2,700	2,700	2,000	1,900	3,900	1,500

Notes

<	The constituent was not detected at a concentration greater than the reported detection limit.
CAS	Chemical abstract service.
MA	Manufacturing area sample.
mg/kg	Milligrams per kilogram
NA	North area sample.
RA	Residue area sample
WA	West area sample.

Table B-3
Soil Data
Eagle Zinc
Hillsboro, Illinois

Constituent	CAS Number	A3-25 RA	A4-01 RA	A4-03 RA	A4-15 RA	A4-15D RA	A4-17 RA	A4-22 RA	MA-06 MA	MA-09 MA	NA-08 NA	NA-09 NA	NA-09D NA	WA-08 WA	WA-09 WA
Inorganics (mg/kg)															
Aluminum	7429905	23,000	20,000	33,000	25000*	28,000	18,000	18,000	26,000	24,000	26,000	26000*	29,000	9,500	14,000
Antimony	7440360	<0 73	<0.36	<0.38	<0.83*	<0 93	0 71	0.62	0 96	<2	0.66	0.42	<0 81*	0 96	<0.43
Arsenic	7440382	8.2	3.4	3.3	11*	13	9.3	8 4	11	7 2	4	6 3	5*	6.4	2 3
Barium	7440393	220	120	120	490	290*	120	170	160	220	65	260*	280	130	140
Beryllium	7440417	1.2	0.97	1 9	2 5*	2.8	1 5	0.85	1 3	1.3	1 1	1 4	1 1*	0.61	0.69
Cadmium	7440439	33	0 41	1.5	1	0.51*	1.2	1 3	2	8 2	0.12	0.83	0.55*	25	70
Calcium	7440702	2,500	1,900	2,800	3,300	3200*	1,300	1,500	2,500	2,100	3,200	1700*	2,200	1,600	970
Chromium	7440473	29	27	35	33*	38	24	20	30	33	27	30*	32	12	16
Cobalt	7440484	4.7	17	5.3	29	6.7*	4 7	9 7	4.4	12	4	6 4*	9	7.7	2.1
Copper	7440508	19	11	17	24	24*	11	12	23	21	11	24	23*	18	17
Iron	7439896	25,000	12,000	16,000	29000*	35,000	24,000	19,000	29,000	27,000	15,000	26,000	23000*	47,000	9,100
Lead	7439921	12	15	13	20	14*	28	21	12	10	12	12*	13	100	48
Magnesium	7439954	3,700	2,000	3,300	4100*	4,400	2,000	2,200	4,300	3,900	2,600	3800*	4,300	1,300	1,500
Manganese	7439965	410	1,200	100	1,900	360*	920	420	240	550	38	170*	230	580	120
Mercury	7439976	0.043	0.013	0.031	0 039	0 035*	0.019	<0 0051	0 03	0 022	0.022	0 043*	0 056	0 038	0.27
Nickel	7440020	21	24	19	93	35*	13	12	21	23	15	21	20*	8 6	8.8
Potassium	7440097	2,600	690	1,500	1700*	2,100	1,300	1,300	2,100	2,100	1,300	1,700	1700*	860	1,200
Selenium	7782492	<0 57	<0 61	1.7	<1 7*	<1 8	<1.5	<0 79	<0.27	<1 5	<0 33	<0.28*	<0.62	<0.31	<0 3
Silver	7440224	<0.15	<0.073	<0.075	<0.17*	<0 19	<0.075	<0.074	<0 086	<0.40	<0 078	<0.074*	<0.16	0.0094	<0 087
Sodium	7440235	280	120	210	350*	390	63	83	220	110	270	100*	130	120	26
Thallium	7440280	<0 68	1.2	<1.7	<2*	<2.1	<1.8	1 1	1 4	<1 8	<0 39	0 89	<0.74*	2 1	<0 36
Vanadium	7440622	53	37	48	59*	66	50	42	62	51	41	55	52*	28	26
Zinc	7440666	1,700	50	350	190*	400	990	420	550	2,500	130	350	270*	2,200	1,400

Notes.

<	*The constituent was not detected at a concentration greater than the reported detection limit*
CAS	Chemical abstract service.
MA	Manufacturing area sample.
mg/kg	Milligrams per kilogram
NA	North area sample.
RA	Residue area sample
WA	West area sample.

Table B-4
Surface Water Background Data
Eagle Zinc
Hillsboro, Illinois

Constituent	CAS Number	SW-ED-11 Background 03/10/03	SW-WD-11 Background 03/10/03	SW-WD-10 Background 03/10/03	Eastern Background	Western Background
Inorganics (mg/L)						
Aluminum	7429905	0.17	1.1	0.21	0.17	1.1
Antimony	7440360	<0.0025	0 0003	<0.0025	ND	0.0003
Arsenic	7440382	<0.0081	0.0023	<0 0081	ND	0 0023
Barium	7440393	0.14	0.087	0 05	0.14	0.087
Beryllium	7440417	<0.0061	0 00021	<0 0061	ND	0 00021
Cadmium	7440439	<0 00053	0 00019	0.0058	ND	0 0058
Calcium	7440702	88	38	100	88	100
Chromium	7440473	0.001	0.0016	<0.00093	0 001	0 0016
Cobalt	7440484	<0.0009	0.00081	0.0044	ND	0 0044
Copper	7440508	0 0044	0.0037	0.0059	0 0044	0.0059
Iron	7439896	0 28	1.4	15	0 28	15
Lead	7439921	<0.0013	0.0038	<0 0013	ND	0 0038
Magnesium	7439954	12	11	26	12	26
Manganese	7439965	0.11	0 25	0 49	0 11	0 49
Mercury	7439976	<0 000028	<0.0003	0 000034	ND	0 000034
Nickel	7440020	0.0025	0 0029	0 013	0 0025	0.013
Potassium	7440097	5 7	5	5.4	5.7	5.4
Selenium	7782492	<0.0048	0 0013	<0 0048	ND	0.0013
Silver	7440224	<0.0011	0.00008	<0 0011	ND	0.00008
Sodium	7440235	29	17	62	29	62
Sulfate	14808798	21	*NS*	95	21	95
Thallium	7440280	<0 0043	<0.00012	<0.0043	ND	ND
Vanadium	7440622	0.0015	0.0047	<0.00084	0.0015	0.0047
Zinc	7440666	1.4	<0 072	3 7	1 4	3.7
Organics (µg/L)						
cis-1,2-Dichloroethene	156592	<0.0081	*NS*	<0.0081	ND	ND
Trichloroethylene	79016	<0 00039	*NS*	<0.00039	ND	ND

Notes.

NS	Not sampled
<	The constituent was not detected at a concentration greater than the reported detection limit
CAS	*Chemical abstract service*
mg/L	Milligrams per liter.
ND	Not detected.
µg/L	Micrograms per liter

Table B-5
Sediment Background Data
Eagle Zinc
Hillsboro, Illinois

Constituent	CAS Number	SD-ED-11 Background	SD-WD-05 Background	SD-WD-06 Background	SD-WD-10 Background	Eastern Background	Western Background
Inorganics (mg/kg)							
Aluminum	7429905	6000	2800	4200	12000	6000	12000
Antimony	7440360	0.42	0.58	1.7	2.1	0.42	2.1
Arsenic	7440382	2.1	5.4	8	15	2.1	15
Barium	7440393	68	65	67	86	68	86
Beryllium	7440417	0.42	0.45	0.52	0.92	0.42	0.92
Cadmium	7440439	0.91	0.48	23	1.4	0.91	23
Calcium	7440702	1900	18000	3600	5500	1900	18000
Chromium	7440473	11	7.3	10	27	11	27
Cobalt	7440484	1.8	3.5	4.1	6.1	1.8	6.1
Copper	7440508	7.5	9.6	51	30	7.5	51
Iron	7439896	5100	11000	20000	16000	5100	20000
Lead	7439921	14	28	290	46	14	290
Magnesium	7439954	740	2100	1000	1800	740	2100
Manganese	7439965	130	480	380	100	130	480
Mercury	7439976	0.013	0.0093	0.9	0.057	0.013	0.9
Nickel	7440020	5	6.5	12	16	5	16
Potassium	7440097	720	320	400	1200	720	1200
Selenium	7782492	<0.49	<0.64	<0.62	<1.1	ND	ND
Silver	7440224	<0.074	<0.1	<0.2	<0.15	ND	ND
Sodium	7440235	<69	150	<23	<96	ND	150
Vanadium	7440622	14	11	13	26	14	26
Zinc	7440666	460	310	10000	920	460	10000
Organics (µg/kg)							
2-Butanone	78933	*NS*	*NS*	*NS*	*NS*	ND	ND
Acetone	67641	*NS*	*NS*	*NS*	*NS*	ND	ND
cis-1,2-Dichloroethene	156592	*NS*	*NS*	*NS*	*NS*	ND	ND
trans-1,2-Dichloroethene	156605	*NS*	*NS*	*NS*	*NS*	ND	ND
Trichloroethylene	79016	*NS*	*NS*	*NS*	*NS*	ND	ND
Vinyl Chloride	75014	*NS*	*NS*	*NS*	*NS*	ND	ND

Notes:
NS Not sampled
< The constituent was not detected at a concentration greater than the reported detection limit
CAS Chemical abstract service
mg/kg Milligrams per kilogram.
ND Not detected
µg/kg Micrograms per kilogram.

Table B-6
Soil Background Data
Eagle Zinc
Hillsboro, Illinois

Constituent	CAS Number	Counties Within Metropolitan Statistical Areas (a)	Counties Outside Metropolitan Statistical Areas (a)
Inorganics (mg/kg)			
Aluminum	7429905	9500	9200
Antimony	7440360	4	3 3
Arsenic	7440382	13	11 3
Barium	7440393	110	122
Beryllium	7440417	0.59	0 56
Cadmium	7440439	0 6	0 5
Calcium	7440702	9300	5525
Chromium	7440473	16 2	13
Cobalt	7440484	8.9	8.9
Copper	7440508	19 6	12
Iron	7439896	15900	15000
Lead	7439921	36	20 9
Magnesium	7439954	4820	2700
Manganese	7439965	636	630
Mercury	7439976	0.06	0 05
Nickel	7440020	18	13
Potassium	7440097	1268	1100
Sodium	7440235	130	130
Thallium	7440280	0 32	0 42
Vanadium	7440622	25 2	25
Zinc	7440666	95	60.2

Notes
CAS Chemical abstract service
mg/kg Milligrams per kilogram.

(a) Approach To Corrective Action Objectives, Chapter I: Pollution Control Board, Section 742 Appendix A General, Section 742. Table G Concentrations Of Inorganic Chemicals In Background Soils
http./www.legis state il us/commission/jcar/admincode/035/03500742ZZ9997agR

APPENDIX C

OCCURRENCE OF CONSTITUENTS

Table C-1
Identification of Sample Locations: On Site, Off Site, Eastern Drainage, Western Drainage, and Background Samples
Eagle Zinc
Hillsboro, Illinois

		Date	Onsite	Offsite	East Onsite	West Onsite	East Offsite	West Offsite	Background
Soil	A1-03	7/15/2002	X						
	A1-06	7/15/2002	X						
	A1-07	7/15/2002	X						
	A1-23	7/16/2002	X						
	A1-24	7/16/2002	X						
	A2-07	7/18/2002	X						
	A2-15	7/18/2002	X						
	A2-19	7/18/2002	X						
	A2-23	7/18/2002	X						
	A2-24	7/18/2002	X						
	A3-19	7/19/2002	X						
	A3-20	7/19/2002	X						
	A3-22	7/19/2002	X						
	A3-23	7/19/2002	X						
	A3-25	7/18/2002	X						
	A4-01	7/19/2002	X						
	A4-03	7/19/2002	X						
	A4-15	7/19/2002	X						
	A4-15D	7/19/2002	X						
	A4-17	7/19/2002	X						
	A4-22	7/19/2002	X						
	MA-06	7/17/2002	X						
	MA-09	7/17/2002	X						
	NA-08	7/17/2002	X						
	NA-09	7/17/2002	X						
	NA-09D	7/17/2002	X						
	WA-08	7/17/2002	X						
	WA-09	7/17/2002	X						
Surface Water									
	SW-ED-11	3/10/2003							X
	SW-ED-13	3/10/2003		X			X		
	SW-ED-16	3/10/2003		X			X		
	SW-WD-06a	3/10/2003		X				X	
	SW-WD-06b	6/13/2003		X				X	
	SW-WD-06bd	6/13/2003		X				X	
	SW-WD-07	3/10/2003		X				X	
	SW-WD-07D	3/10/2003		X				X	
	SW-WD-08	*3/10/2003*		X				X	
	SW-WD-09	3/10/2003	X			X			
	SW-WD-10	3/10/2003							X
	SW-WD-11	6/13/2003							X
	SW-WD-12	6/13/2003		X				X	
	SW-WD-PN	3/10/2003	X			X			
	SW-WD-PS	3/10/2003	X			X			

Table C-1

Identification of Sample Locations: On Site, Off Site, Eastern Drainage, Western Drainage, and Background Samples

Eagle Zinc

Hillsboro, Illinois

	Date	Onsite	Offsite	East Onsite	West Onsite	East Offsite	West Offsite	Background
Sediment								
SD-ED-11	7/9/2002							X
SD-ED-12	7/9/2002	X		X				
SD-ED-13	7/9/2002		X			X		
SD-ED-14	7/8/2002		X			X		
SD-ED-15	7/8/2002		X			X		
SD-ED-16	7/8/2002		X			X		
SD-WD-01	7/8/2002		X				X	
SD-WD-02	7/8/2002		X				X	
SD-WD-03	7/8/2002		X				X	
SD-WD-04	7/8/2002		X				X	
SD-WD-05	7/8/2002							X
SD-WD-06	7/8/2002		X				X	
SD-WD-07	7/8/2002		X				X	
SD-WD-08	7/9/2002		X				X	
SD-WD-09	7/9/2002	X			X			
SD-WD-09d	7/9/2002	X			X			
SD-WD-10	7/8/2002							X

Table C-2a
Occurrence of Constituents in Surface Water (On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min - Max (mg/L)	Range of Detects Min - Max (mg/L)	UCL (mg/L)	EPC (mg/L)	
Inorganics						
Aluminum	1 / 3	0 027 - 0.027	0 037	0.51	0 037	m
Antimony	0 / 3	0 0025 - 0 0025	ND	ND	ND	
Arsenic	0 / 3	0 0081 - 0 0081	ND	ND	ND	
Barium	3 / 3		0 024 - 0 041	0 086	0 041	m
Beryllium	0 / 3	0 00061 - 0.00061	ND	ND	ND	
Cadmium	3 / 3		0 069 - 0 23	5 8	0 23	m
Calcium	3 / 3		110 - 120	130	120	m
Chromium	0 / 3	0 00093 - 0 00093	ND	ND	ND	
Cobalt	2 / 3	0.0009	0.0019 - 0 0024	3 8	0 0024	m
Copper	3 / 3		0.0017 - 0.0026	0 0038	0 0026	m
Iron	3 / 3		0.056 - 0.17	4.1	0.17	m
Lead	2 / 3	0.0013	0.0022 - 0.0032	1 4	0 0032	m
Magnesium	3 / 3		33 - 38	42	38	m
Manganese	3 / 3		0 01 - 0 3	NA	0 3	m
Mercury	0 / 3	2.8E-05 - 2 8E-05	ND	ND	ND	
Nickel	3 / 3		0.026 - 0.036	0 044	0.036	m
Potassium	3 / 3		13 - 17	20	17	m
Selenium	0 / 3	0.0048 - 0.0048	ND	ND	ND	
Silver	0 / 3	0 0011 - 0.0011	ND	ND	ND	
Sodium	3 / 3		41 - 57	70	57	m
Sulfate	3 / 3		420 - 450	460	450	m
Thallium	0 / 3	0 0043 - 0 0043	ND	ND	ND	
Vanadium	0 / 3	0 00084 - 0 00084	ND	ND	ND	
Zinc	3 / 3		14 - 26	52	26	m
Organics						
cis-1,2-Dichloroethene	2 / 2		0 000002 - 2.2E-06	NA	0 0000022	m
Trichloroethylene	2 / 2		1.4E-06 - 6.3E-06	NA	0 0000063	m

Notes:

EPC Exposure point concentration (rounded to two significant figures).
m The calculated UCL exceeds maximum concentration; the maximum concentration is the EPC
mg/L Milligrams per liter
NA Not applicable
ND Not detected
SQLs Sample quantitation limit
UCL The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987.

Table C-2b
Occurrence of Constituents In Surface Water (Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min - Max (mg/L)	Range of Detects Min - Max (mg/L)	UCL (mg/L)	EPC (mg/L)	
Inorganics						
Aluminum	4 / 9	0.027 - 0.076	0.031 - 1 4	1 4	1.4	u
Antimony	3 / 9	0 0025 - 0 0025	0 00026 - 0 00032	0 002	0.00032	m
Arsenic	3 / 9	0.0081 - 0.0081	0.0012 - 0 0022	0.0052	0.0022	m
Barium	9 / 9		0 021 - 0.089	0.071	0.071	u
Beryllium	1 / 9	0.0001 - 0.00061	0.00018	0 00055	0.00018	m
Cadmium	8 / 9	0.00053	0 0012 - 0.034	0 3	0 034	m
Calcium	9 / 9		42 - 150	150	150	u
Chromium	4 / 9	0 00093 - 0.00093	0.00061 - 0.0018	0.001	0 001	u
Cobalt	5 / 9	0 0009 - 0.0009	0 00084 - 0.0016	0.0011	0 0011	u
Copper	9 / 9		0.0011 - 0.0049	0.0051	0 0049	m
Iron	9 / 9		0 23 - 3.2	2	2	u
Lead	5 / 9	0 0013 - 0.0013	0.0022 - 0 0052	0 0048	0.0048	u
Magnesium	9 / 9		14 - 36	33	33	u
Manganese	9 / 9		0 077 - 0 62	0 68	0 62	m
Mercury	1 / 9	0 00002 - 0.0002	0.00003	0 000045	0 00003	m
Nickel	9 / 9		0 0018 - 0 019	0 023	0 019	m
Potassium	9 / 9		3 6 - 9.2	7 9	7.9	u
Selenium	3 / 9	0 0048 - 0 0048	0 0014 - 0.002	0.0025	0.002	m
Silver	2 / 9	4 9E-05 - 0 0011	0 00006 - 0 00006	0 0032	0 00006	m
Sodium	9 / 9		15 - 60	58	58	u
Sulfate	6 / 6		130 - 330	330	330	u
Thallium	0 / 9	0.00012 - 0 0043	ND	ND	ND	
Vanadium	4 / 9	0.00084 - 0 00084	0 00065 - 0 0051	0 0021	0 0021	u
Zinc	9 / 9		0 71 - 26	110	26	m
Organics						
cis-1,2-Dichloroethene	0 / 3	8 1E-07 - 8 1E-07	ND	ND	ND	
Trichloroethylene	0 / 3	3.9E-07 - 3 9E-07	ND	ND	ND	

Notes:

EPC	Exposure point concentration (rounded to two significant figures)
m	The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC
mg/L	Milligrams per liter
ND	The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC
SQLs	Sample quantitation limit
u	The calculated UCL is less than maximum concentration, the UCL is the EPC.
UCL	The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987

Table C-3a
Occurrence of Constituents in Sediment (On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min - Max (mg/kg)	Range of Detects Min - Max (mg/kg)	UCL (mg/kg)	EPC (mg/kg)	
Metals						
Aluminum	3 / 3		6,100 - 7,600	9,100	7,600	m
Antimony	3 / 3		0.62 - 2 1	170	2 1	m
Arsenic	3 / 3		2.4 - 7 9	160	7 9	m
Barium	3 / 3		67 - 82	92	82	m
Beryllium	3 / 3		0.36 - 0 67	1 8	0 67	m
Cadmium	3 / 3		2.4 - 550	NA	550	m
Calcium	3 / 3		1,300 - 2,400	6,200	2,400	m
Chromium	3 / 3		11 - 17	24	17	m
Cobalt	3 / 3		1.2 - 11	NA	11	m
Copper	3 / 3		8 9 - 65	NA	65	m
Iron	3 / 3		5,100 - 29,000	NA	29,000	m
Lead	3 / 3		25 - 240	NA	240	m
Magnesium	3 / 3		760 - 1,000	1,300	1,000	m
Manganese	3 / 3		70 - 230	4,500	230	m
Mercury	3 / 3		0.019 - 1 7	NA	1 7	m
Nickel	3 / 3		4.6 - 29	390,000	29	m
Potassium	3 / 3		660 - 730	760	730	m
Selenium	2 / 3	0 53	1.1 - 1 1	490	1.1	m
Silver	2 / 3	0.079	0.37 - 0.38	NA	0 38	m
Sodium	0 / 3	26 - 92	ND	ND	ND	
Vanadium	3 / 3		13 - 34	200	34	m
Zinc	3 / 3		830 - 12,000	NA	12,000	m
Organics						
2-Butanone	2 / 2		0.0086 - 0.02	NA	0 02	m
Acetone	2 / 2		0 026 - 0.049	NA	0 049	m
cis-1,2-Dichloroethene	2 / 3	0 0014	0.0041 - 0 086	NA	0.086	m
trans-1,2-Dichloroethene	2 / 3	0 0012	0.0056 - 0.02	NA	0 02	m
Trichloroethylene	2 / 3	0.0014	0.003 - 0.0045	23	0.0045	m
Vinyl Chloride	2 / 3	0.0013	0 0025 - 0.013	NA	0 013	m

Notes
EPC Exposure point concentration (rounded to two significant figures)
m The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC.
mg/kg Milligrams per kilogram
NA Not applicable.
ND Not detected
SQLs *Sample quantitation limit*
UCL The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987.

Table C-3b
Occurrence of Constituents in Sediment (Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min – Max (mg/kg)	Range of Detects Min – Max (mg/kg)	UCL (mg/kg)	EPC (mg/kg)	
Metals						
Aluminum	11 / 11		2,300 – 19,000	10,000	10,000	u
Antimony	10 / 11	0 45	0 48 – 12	6.7	6.7	u
Arsenic	11 / 11		2 5 – 25	11	11	u
Barium	11 / 11		30 – 190	97	97	u
Beryllium	11 / 11		0.27 – 1.1	0 69	0 69	u
Cadmium	11 / 11		0.83 – 96	120	96	m
Calcium	11 / 11		2,600 – 23,000	16,000	16,000	u
Chromium	11 / 11		5.9 – 26	16	16	u
Cobalt	11 / 11		1.9 – 14	9.8	9 8	u
Copper	11 / 11		4 8 – 320	250	250	u
Iron	11 / 11		6,900 – 45,000	24,000	24,000	u
Lead	11 / 11		20 – 2,700	1,800	1,800	u
Magnesium	11 / 11		1,000 – 5,400	3,500	3,500	u
Manganese	11 / 11		110 – 750	590	590	u
Mercury	10 / 11	0.0046	0 012 – 1.4	5.7	1 4	m
Nickel	11 / 11		4.2 – 27	22	22	u
Potassium	11 / 11		270 – 1,400	800	800	u
Selenium	1 / 11	0 44 – 0.73	1 4	0.53	0 53	u
Silver	6 / 11	0.066 – 0.1	0 089 – 2 4	3 1	2 4	m
Sodium	0 / 11	21 – 89	ND	ND	ND	
Vanadium	11 / 11		7 8 – 30	22	22	u
Zinc	11 / 11		400 – 23,000	63,000	23,000	m
Organics						
cis-1,2-Dichloroethene	0 / 2	0.0012 – 0.0017	ND	ND	ND	
trans-1,2-Dichloroethene	0 / 2	0.001 – 0.0014	ND	ND	ND	
Trichloroethylene	0 / 2	0.0012 – 0.0017	ND	ND	ND	
Vinyl Chloride	0 / 2	0 0011 – 0 0015	ND	ND	ND	

Notes
EPC Exposure point concentration (rounded to two significant figures).
m The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC
ND Not detected.
mg/kg Milligrams per kilogram
SQLs Sample quantitation limit
u The calculated UCL is less than maximum concentration, the UCL is the EPC.
UCL The 95 percent upper confidence limit on the mean (lognormal distribution) Gilbert, 1987

Table C-4
Occurrence of Constituents in Surface Soil (On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min – Max (mg/kg)	Range of Detects Min – Max (mg/kg)	UCL (mg/kg)	EPC (mg/kg)	
<u>Metals</u>						
Aluminum	26 / 26		8,300 – 33,000	25,000	25,000	u
Antimony	14 / 26	0.33 – 2	0.34 – 1.9	0.79	0.79	u
Arsenic	26 / 26		1.9 – 13	8.3	8.3	u
Barium	26 / 26		46 – 490	180	180	u
Beryllium	26 / 26		0.61 – 2.8	1.3	1.3	u
Cadmium	26 / 26		0.12 – 87	73	73	u
Calcium	26 / 26		530 – 36,000	4,600	4,600	u
Chromium	26 / 26		12 – 38	29	29	u
Cobalt	26 / 26		2.1 – 29	8.7	8.7	u
Copper	26 / 26		9.1 – 35	19	19	u
Iron	26 / 26		9,100 – 47,000	26,000	26,000	u
Lead	26 / 26		7.4 – 100	23	23	u
Magnesium	26 / 26		1,300 – 22,000	4,800	4,800	u
Manganese	26 / 26		38 – 1,900	630	630	u
Mercury	23 / 26	0.005 – 0.005	0.006 – 0.27	0.057	0.057	u
Nickel	26 / 26		8.6 – 93	22	22	u
Potassium	26 / 26		690 – 2,600	1,900	1,900	u
Selenium	2 / 26	0.27 – 1.8	1.7 – 1.7	0.55	0.55	u
Silver	2 / 26	0.067 – 0.4	0.009 – 0.42	0.094	0.094	u
Sodium	26 / 26		20 – 390	160	160	u
Thallium	16 / 26	0.36 – 2.1	0.41 – 2.1	1.1	1.1	u
Vanadium	26 / 26		16 – 72	52	52	u
Zinc	26 / 26		50 – 11,000	4,600	4,600	u

Notes.

EPC Exposure point concentration (rounded to two significant figures)
mg/kg Milligrams per kilogram
SQLs Sample quantitation limit.
u The calculated UCL is less than maximum concentration, the UCL is the EPC.
UCL The 95 percent upper confidence limit on the mean (lognormal distribution) Gilbert, 1987

Table C-5a
Classification of Illinois EPA Sieved Stream Sediment Data
Eagle Zinc
Hillsboro, Illinois

Constituent	SIEVED (a) Non-Elevated Less than (mg/kg)	SIEVED (a) Elevated: Greater than (mg/kg)	SIEVED (a) Highly Elevated: Greater than (mg/kg)	UNSIEVED (b) Non-Elevated. Less than (mg/kg)	UNSIEVED (b) Slightly Elevated. Greater than (mg/kg)	UNSIEVED (b) Elevated· Greater than (mg/kg)	UNSIEVED (b) Highly Elevated. Greater than (mg/kg)	UNSIEVED (b) Extremely Elevated. Greater than (mg/kg)
Metals								
Arsenic	7.2	7.2	18	8	8	11	17	28
Barium	145	145	230	NA	NA	NA	NA	NA
Cadmium	2	2	9 3	0.5	0.5	1	2	20
Chromium	16	23	38	16	16	23	38	60
Copper	37	37	110	38	38	60	100	200
Iron	26,105	26,105	53,000	18,000	18,000	23,000	32,000	50,000
Lead	60	60	245	28	28	38	60	100
Manganese	1,100	1,100	2,300	1,300	1,300	1,800	2,800	5,000
Mercury	0 28	0.28	1.4	0 07	0 07	0.1	0 17	0 3
Nickel	26	26	45	NA	NA	NA	NA	NA
Potassium	1,500	1,500	2,200	NA	NA	NA	NA	NA
Silver	5	NA	5	NA	NA	NA	NA	NA
Zinc	170	170	760	80	80	100	170	300

mg/kg Milligrams per kilogram.
NA No screening criterion is available

(a) Classification of Illinois EPA Sieved Stream Sediment Data Collected from 1982-1995 (IEPA, 1997).
(b) Classification of Illinois Stream Sediments, unsieved (from Kelly and Hite, 1984)

Table C-5b
Comparison of On Site and Off Site Maximum Detected Sediment Concentrations With Sieved Stream Sediment Data
Eagle Zinc
Hillsboro, Illinois

Constituent	ON SITE Maximum Sediment Concentration (a) (mg/kg)	ON SITE Comparison to Illinois Sieved Stream Sediment Data (b)	OFF SITE Maximum Sediment Concentration (a) (mg/kg)	OFF SITE Comparison to Illinois Sieved Stream Sediment Data (b)
Metals				
Aluminum	7,600	NA	19,000	NA
Antimony	2.1	NA	12	NA
Arsenic	7 9	Elevated	25	Highly Elevated
Barium	82	Not Elevated	190	Elevated
Beryllium	0 67	NA	1 1	NA
Cadmium	550	Highly Elevated	96	Highly Elevated
Calcium	2,400	NA	23,000	NA
Chromium	17	Not Elevated	26	Elevated
Cobalt	11	NA	14	NA
Copper	65	Elevated	320	Highly Elevated
Iron	29,000	Elevated	45,000	Elevated
Lead	240	Elevated	2,700	Highly Elevated
Magnesium	1,000	NA	5,400	NA
Manganese	230	Not Elevated	750	Not Elevated
Mercury	1 7	Highly Elevated	1 4	Elevated
Nickel	29	Elevated	27	Elevated
Potassium	730	Not Elevated	1,400	Not Elevated
Selenium	1.1	NA	1 4	NA
Silver	0.38	Not Elevated	2 4	Not Elevated
Sodium	ND	NA	ND	NA
Vanadium	34	NA	30	NA
Zinc	12,000	Highly Elevated	23,000	Highly Elevated
Organics				
2-Butanone	0 02	NA	ND	NA
Acetone	0 049	NA	ND	NA
cis-1,2-Dichloroethene	0 086	NA	ND	NA
trans-1,2-Dichloroethene	0 02	NA	ND	NA
Trichloroethylene	0 0045	NA	ND	NA
Vinyl Chloride	0 013	NA	ND	NA

Notes
mg/kg Milligrams per kilogram.
NA Not applicable.
ND Not detected

(a) Occurrence of constituents summarized on Table C-3a and Table C-3b.
(b) The sediment classifications are summarized on Table C-5a

Table C-5c
Comparison of On Site and Off Site Maximum Detected Sediment Concentrations With Unsieved Stream Sediment Data
Eagle Zinc
Hillsboro, Illinois

Constituent	ON SITE Maximum Sediment Concentration (a) (mg/kg)	ON SITE Comparison to Illinois Sieved Stream Sediment Data (b)	OFF SITE Maximum Sediment Concentration (a) (mg/kg)	OFF SITE Comparison to Illinois Sieved Stream Sediment Data (b)
Metals				
Aluminum	7,600	NA	19,000	NA
Antimony	2.1	NA	12	NA
Arsenic	7.9	Not Elevated	25	Highly Elevated
Barium	82	NA	190	NA
Beryllium	0 67	NA	1.1	NA
Cadmium	550	Extremely Elevated	96	Extremely Elevated
Calcium	2,400	NA	23,000	NA
Chromium	17	Slightly Elevated	26	Elevated
Cobalt	11	NA	14	NA
Copper	65	Elevated	320	Extremely Elevated
Iron	29,000	Elevated	45,000	Highly Elevated
Lead	240	Extremely Elevated	2,700	Extremely Elevated
Magnesium	1,000	NA	5,400	NA
Manganese	230	Not Elevated	750	Not Elevated
Mercury	1 7	Extremely Elevated	1.4	Extremely Elevated
Nickel	29	NA	27	NA
Potassium	730	NA	1,400	NA
Selenium	1 1	NA	1.4	NA
Silver	0 38	NA	2 4	NA
Sodium	ND	NA	ND	NA
Vanadium	34	NA	30	NA
Zinc	12,000	Extremely Elevated	23,000	Extremely Elevated
Organics				
2-Butanone	0.02	NA	ND	NA
Acetone	0.049	NA	ND	NA
cis-1,2-Dichloroethene	0 086	NA	ND	NA
trans-1,2-Dichloroethene	0 02	NA	ND	NA
Trichloroethylene	0.0045	NA	ND	NA
Vinyl Chloride	0 013	NA	ND	NA

Notes:
mg/kg Milligrams per kilogram.
NA Not applicable
ND Not detected.

(a) Occurrence of constituents summarized on Table C-3a and Table C-3b
(b) The sediment classifications are summarized on Table C-5a.

Table C-6a
Occurrence of Constituents in Surface Water (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min – Max (mg/L)	Range of Detects Min – Max (mg/L)	UCL (mg/L)	EPC (mg/L)	
Inorganics						
Aluminum	2 / 2		0.031 – 0 13	NA	0 13	m
Antimony	0 / 2	0 0025 – 0 0025	ND	ND	ND	
Arsenic	0 / 2	0.0081 – 0.0081	ND	ND	ND	
Barium	2 / 2		0.05 – 0 071	NA	0 071	m
Beryllium	0 / 2	0.00061 – 0 00061	ND	ND	ND	
Cadmium	1 / 2	0 00053	0 0071	NA	0 0071	m
Calcium	2 / 2		42 – 80	NA	80	m
Chromium	1 / 2	0.00093	0.0011	NA	0 0011	m
Cobalt	0 / 2	0 0009 – 0.0009	ND	ND	ND	
Copper	2 / 2		0 002 – 0 004	NA	0 004	m
Iron	2 / 2		0.23 – 0 28	NA	0.28	m
Lead	0 / 2	0.0013 – 0.0013	ND	ND	ND	
Magnesium	2 / 2		14 – 27	NA	27	m
Manganese	2 / 2		0 1 – 0.38	NA	0 38	m
Mercury	0 / 2	2 8E-05 – 2 8E-05	ND	ND	ND	
Nickel	2 / 2		0 0018 – 0 012	NA	0 012	m
Potassium	2 / 2		3 6 – 5 2	NA	5 2	m
Selenium	0 / 2	0.0048 – 0 0048	ND	ND	ND	
Silver	0 / 2	0 0011 – 0 0011	ND	ND	ND	
Sodium	2 / 2		15 – 41	NA	41	m
Sulfate	2 / 2		130 – 160	NA	160	m
Thallium	0 / 2	0.0043 – 0 0043	ND	ND	ND	
Vanadium	1 / 2	0.00084	0 00087	NA	0 00087	m
Zinc	2 / 2		0 84 – 11	NA	11	m
Organics						
cis-1,2-Dichloroethene	0 / 1	8.1E-07	ND	ND	ND	
Trichloroethylene	0 / 1	3 9E-07	ND	ND	ND	

Notes:

EPC	Exposure point concentration (rounded to two significant figures)
m	The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC
mg/L	Milligrams per liter.
NA	Not applicable
ND	Not detected.
SQLs	Sample quantitation limit
UCL	The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987.

Table C-6b
Occurrence of Constituents in Surface Water (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min – Max (mg/L)	Range of Detects Min – Max (mg/L)	UCL (mg/L)	EPC (mg/L)	
Inorganics						
Aluminum	1 / 3	0.027 – 0 027	0 037	0.51	0.037	m
Antimony	0 / 3	0 0025 – 0 0025	ND	ND	ND	
Arsenic	0 / 3	0 0081 – 0 0081	ND	ND	ND	
Barium	3 / 3		0 024 – 0 041	0 086	0 041	m
Beryllium	0 / 3	0.00061 – 0 00061	ND	ND	ND	
Cadmium	3 / 3		0.069 – 0.23	5 8	0 23	m
Calcium	3 / 3		110 – 120	130	120	m
Chromium	0 / 3	0.00093 – 0.00093	ND	ND	ND	
Cobalt	2 / 3	0 0009	0 0019 – 0 0024	3.8	0.0024	m
Copper	3 / 3		0.0017 – 0.0026	0.0038	0 0026	m
Iron	3 / 3		0.056 – 0.17	4.1	0.17	m
Lead	2 / 3	0.0013	0.0022 – 0.0032	1.4	0 0032	m
Magnesium	3 / 3		33 – 38	42	38	m
Manganese	3 / 3		0 01 – 0.3	NA	0 3	m
Mercury	0 / 3	2 8E-05 – 2.8E-05	ND	ND	ND	
Nickel	3 / 3		0.026 – 0.036	0 044	0 036	m
Potassium	3 / 3		13 – 17	20	17	m
Selenium	0 / 3	0.0048 – 0.0048	ND	ND	ND	
Silver	0 / 3	0.0011 – 0.0011	ND	ND	ND	
Sodium	3 / 3		41 – 57	70	57	m
Sulfate	3 / 3		420 – 450	460	450	m
Thallium	0 / 3	0.0043 – 0.0043	ND	ND	ND	
Vanadium	0 / 3	0.00084 – 0.00084	ND	ND	ND	
Zinc	3 / 3		14 – 26	52	26	m
Organics						
cis-1,2-Dichloroethene	2 / 2		0.000002 – 2.2E-06	NA	0.0000022	m
Trichloroethylene	2 / 2		1 4E-06 – 6 3E-06	NA	0 0000063	m

Notes:

EPC Exposure point concentration (rounded to two significant figures).
m The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC.
mg/L Milligrams per liter
NA Not applicable
ND Not detected
SQLs Sample quantitation limit
UCL The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987.

Table C-6c
Occurrence of Constituents in Surface Water (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min – Max (mg/L)	Range of Detects Min – Max (mg/L)	UCL (mg/L)	EPC (mg/L)	
Inorganics						
Aluminum	2 / 7	0.027 – 0 076	0.047 – 1 4	7 1	1 4	m
Antimony	3 / 7	0 0025 – 0 0025	0 00026 – 0 00032	0 0024	0.00032	m
Arsenic	3 / 7	0 0081 – 0 0081	0 0012 – 0 0022	0 0058	0.0022	m
Barium	7 / 7		0.021 – 0.089	0.074	0.074	u
Beryllium	1 / 7	0.0001 – 0.00061	0 00018	0.00072	0.00018	m
Cadmium	7 / 7		0.0012 – 0 034	0.23	0.034	m
Calcium	7 / 7		51 – 150	160	150	m
Chromium	3 / 7	0 00093 – 0 00093	0.00061 – 0 0018	0.0011	0 0011	u
Cobalt	5 / 7	0 0009 – 0.0009	0 00084 – 0.0016	0.0013	0 0013	u
Copper	7 / 7		0 0011 – 0 0049	0.0063	0.0049	m
Iron	7 / 7		0.39 – 3.2	2 8	2 8	u
Lead	5 / 7	0 0013 – 0.0013	0.0022 – 0 0052	0.0069	0 0052	m
Magnesium	7 / 7		14 – 36	35	35	u
Manganese	7 / 7		0.077 – 0 62	0 98	0 62	m
Mercury	1 / 7	0 00002 – 0.0002	0.00003	0 000074	0 00003	m
Nickel	7 / 7		0.0029 – 0.019	0 024	0 019	m
Potassium	7 / 7		5 1 – 9.2	8 5	8 5	u
Selenium	3 / 7	0 0048 – 0 0048	0 0014 – 0 002	0.0025	0.002	m
Silver	2 / 7	4.9E-05 – 0.0011	0.00006 – 0.00006	0 0072	0 00006	m
Sodium	7 / 7		24 – 60	60	60	u
Sulfate	4 / 4		210 – 330	350	330	m
Thallium	0 / 7	0 00012 – 0 0043	ND	ND	ND	
Vanadium	3 / 7	0 00084 – 0 00084	0 00065 – 0 0051	0.0038	0.0038	u
Zinc	7 / 7		0 71 – 26	290	26	m
Organics						
cis-1,2-Dichloroethene	0 / 2	8.1E-07 – 8.1E-07	ND	ND	ND	
Trichloroethylene	0 / 2	3 9E-07 – 3.9E-07	ND	ND	ND	

Notes.

EPC Exposure point concentration (rounded to two significant figures)
m The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC
mg/L Milligrams per liter
ND Not detected
SQLs Sample quantitation limit
u The calculated UCL is less than maximum concentration; the UCL is the EPC.
UCL The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987.

Table C-7a
Occurrence of Constituents in Sediment (Eastern Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	SD-ED-12 (mg/kg)
Metals	
Aluminum	6,100
Antimony	0 62
Arsenic	2 4
Barium	82
Beryllium	0 36
Cadmium	2 4
Calcium	1,300
Chromium	11
Cobalt	1 2
Copper	8 9
Iron	5,100
Lead	25
Magnesium	760
Manganese	70
Mercury	0 019
Nickel	4.6
Potassium	660
Selenium	<0.53
Silver	<0.079
Sodium	<92
Vanadium	13
Zinc	830
Organics	
cis-1,2-Dichloroethene	<0 0014
trans-1,2-Dichloroethene	<0 0012
Trichloroethylene	<0 0014
Vinyl Chloride	<0 0013

Notes
r The data was flagged with an "R" flag indicated that the sample result was rejected
< The constituent was not detected at a concentration greater than the given detection limit
mg/kg Milligrams per kilogram

Table C-7b
Occurrence of Constituents in Sediment (Eastern Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency *Detects / Total*	Range of SQLs Min – Max *(mg/kg)*	Range of Detects Min – Max *(mg/kg)*	UCL *(mg/kg)*	EPC *(mg/kg)*	
Metals						
Aluminum	4 / 4		3,900 – 9,600	13,000	9,600	m
Antimony	4 / 4		0 84 – 2.3	4 2	2 3	m
Arsenic	4 / 4		3 2 – 7.2	10	7.2	m
Barium	4 / 4		44 – 71	80	71	m
Beryllium	4 / 4		0.39 – 0.75	0.82	0.75	m
Cadmium	4 / 4		2.3 – 13	90	13	m
Calcium	4 / 4		4,100 – 23,000	160,000	23,000	m
Chromium	4 / 4		7.1 – 14	16	14	m
Cobalt	4 / 4		6 – 12	13	12	m
Copper	4 / 4		4.8 – 53	5,900	53	m
Iron	4 / 4		8,500 – 19,000	25,000	19,000	m
Lead	4 / 4		20 – 87	530	87	m
Magnesium	4 / 4		1,800 – 5,400	8,700	5,400	m
Manganese	4 / 4		340 – 750	1,200	750	m
Mercury	3 / 4	0 0046	0 024 – 0 15	31,000	0 15	m
Nickel	4 / 4		7 9 – 17	25	17	m
Potassium	4 / 4		440 – 860	970	860	m
Selenium	0 / 4	0.44 – 0 72	ND	ND	ND	
Silver	2 / 4	0 066 – 0.079	0.39 – 0 46	770	0 46	m
Sodium	0 / 4	21 – 86	ND	ND	ND	
Vanadium	4 / 4		15 – 27	29	27	m
Zinc	4 / 4		530 – 11,000	NA	11,000	m
Organics						
cis-1,2-Dichloroethene	0 / 1	0 0012	ND	ND	ND	
trans-1,2-Dichloroethene	0 / 1	0 001	ND	ND	ND	
Trichloroethylene	0 / 1	0.0012	ND	ND	ND	
Vinyl Chloride	0 / 1	0.0011	ND	ND	ND	

Notes
EPC Exposure point concentration (rounded to two significant figures).
m The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC
mg/kg Milligrams per kilogram
ND Not detected
SQLs Sample quantitation limit
UCL The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987.

Table C-7c
Occurrence of Constituents in Sediment (Western Drainage: On Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	SD-WD-09 (mg/kg)	SD-WD-09d (mg/kg)	Highest Detection (mg/kg)
<u>Metals</u>			
Aluminum	7,500	7,600	7,600
Antimony	2.1	2.1	2.1
Arsenic	7.9	5.1	7.9
Barium	76	67	76
Beryllium	0.65	0.67	0.67
Cadmium	550	550	550
Calcium	2,400	2,300	2,400
Chromium	17	12	17
Cobalt	11	9.3	11
Copper	58	65	65
Iron	29,000	19,000	29,000
Lead	220	240	240
Magnesium	1,000	1,000	1,000
Manganese	230	150	230
Mercury	1.3	1.7	1.7
Nickel	29	25	29
Potassium	690	730	730
Selenium	1.1	1.1	1.1
Silver	0.37	0.38	0.38
Sodium	<28	<26	ND
Vanadium	34	20	34
Zinc	12,000	9,700	12,000
<u>Organics</u>			
2-Butanone	0.0086	0.02	0.02
Acetone	0.026	0.049	0.049
cis-1,2-Dichloroethene	0.0041	0.086	0.086
trans-1,2-Dichloroethene	0.0056	0.02	0.02
Trichloroethylene	0.003	0.0045	0.0045
Vinyl Chloride	0.0025	0.013	0.013

Notes:

< The constituent was not detected at a concentration greater than the given detection limit.

mg/kg Milligrams per kilogram.

Table C-7d
Occurrence of Constituents in Sediment (Western Drainage: Off Site)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min – Max (mg/kg)	Range of Detects Min – Max (mg/kg)	UCL (mg/kg)	EPC (mg/kg)	
Metals						
Aluminum	7 / 7		2,300 – 19,000	17,000	17,000	u
Antimony	6 / 7	0.45	0.48 – 12	35	12	m
Arsenic	7 / 7		2.5 – 25	21	21	u
Barium	7 / 7		30 – 190	150	150	u
Beryllium	7 / 7		0.27 – 1.1	0.87	0.87	u
Cadmium	7 / 7		0.83 – 96	4,500	96	m
Calcium	7 / 7		2,600 – 14,000	15,000	14,000	m
Chromium	7 / 7		5.9 – 26	24	24	u
Cobalt	7 / 7		1.9 – 14	11	11	u
Copper	7 / 7		5.7 – 320	1,400	320	m
Iron	7 / 7		6,900 – 45,000	40,000	40,000	u
Lead	7 / 7		26 – 2,700	50,000	2,700	m
Magnesium	7 / 7		1,000 – 2,700	2,700	2,700	u
Manganese	7 / 7		110 – 420	480	420	m
Mercury	7 / 7		0.012 – 1.4	36	1.4	m
Nickel	7 / 7		4.2 – 27	34	27	m
Potassium	7 / 7		270 – 1,400	1,000	1,000	u
Selenium	1 / 7	0.52 – 0.73	1.4	0.85	0.85	u
Silver	4 / 7	0.09 – 0.1	0.089 – 2.4	25	2.4	m
Sodium	0 / 7	23 – 89	ND	ND	ND	
Vanadium	7 / 7		7.8 – 30	25	25	u
Zinc	7 / 7		400 – 23,000	440,000	23,000	m
Organics						
cis-1,2-Dichloroethene	0 / 1	0.0017	ND	ND	ND	
trans-1,2-Dichloroethene	0 / 1	0.0014	ND	ND	ND	
Trichloroethylene	0 / 1	0.0017	ND	ND	ND	
Vinyl Chloride	0 / 1	0.0015	ND	ND	ND	

Notes:
EPC Exposure point concentration (rounded to two significant figures).
m The calculated UCL exceeds maximum concentration; the maximum concentration is the EPC
mg/kg Milligrams per kilogram
ND Not detected
SQLs Sample quantitation limit.
u The calculated UCL is less than maximum concentration; the UCL is the EPC
UCL The 95 percent upper confidence limit on the mean (lognormal distribution) Gilbert, 1987.

Table C-8a
Occurrence of Constituents in Background Surface Water
Eagle Zinc
Hillsboro, Illinois

Constituent	EAST SW-ED-11 (mg/L)	WEST SW-WD-11 (mg/L)	WEST SW-WD-10 (mg/L)	Eastern Background (a) (mg/L)	Western Background (b) (mg/L)
Inorganics (mg/L)					
Aluminum	0 17	1 1	0 21	0 17	1 1
Antimony	<0 0025	0.0003	<0 0025	ND	0 0003
Arsenic	<0 0081	0.0023	<0 0081	ND	0 0023
Barium	0.14	0.087	0.05	0 14	0 087
Beryllium	<0.0061	0.00021	<0.0061	ND	0 00021
Cadmium	<0.00053	0.00019	0.0058	ND	0.0058
Calcium	88	38	100	88	100
Chromium	0 001	0.0016	<0 00093	0.001	0 0016
Cobalt	<0.0009	0 00081	0 0044	ND	0 0044
Copper	0 0044	0 0037	0 0059	0.0044	0 0059
Iron	0.28	1 4	15	0.28	15
Lead	<0.0013	0.0038	<0 0013	ND	0 0038
Magnesium	12	11	26	12	26
Manganese	0 11	0.25	0 49	0 11	0.49
Mercury	<0.000028	<0.0003	0.000034	ND	0 000034
Nickel	0 0025	0 0029	0.013	0.0025	0 013
Potassium	5 7	5	5.4	5.7	5 4
Selenium	<0 0048	0 0013	<0.0048	ND	0 0013
Silver	<0 0011	0.00008	<0.0011	ND	0 00008
Sodium	29	17	62	29	62
Sulfate	21	*NS*	95	21	95
Thallium	<0 0043	<0 00012	<0.0043	ND	ND
Vanadium	0 0015	0.0047	<0.00084	0.0015	0 0047
Zinc	1 4	<0.072	3 7	1.4	3 7
Organics (µg/L)					
cis-1,2-Dichloroethene	<0 0081	*NS*	<0 0081	ND	ND
Trichloroethylene	<0 00039	*NS*	<0 00039	ND	ND

Notes
NS Not sampled
< The constituent was not detected at a concentration greater than the reported detection limit
mg/L Milligrams per liter.
ND Not detect The calculated UCL exceeds maximum concentration; the maximum concentration is the EPC.
µg/L Micrograms per liter.

(a) The eastern background is equal to the constituent concentration detected in the eastern background sample.
(b) The western background is equal to the highest detected concentration for each constituent in the western samples.

Table C-8b
Occurrence of Constituents in Background Sediment
Eagle Zinc
Hillsboro, Illinois

Constituent	EAST SD-ED-11 (mg/kg)	WEST SD-WD-05 (mg/kg)	WEST SD-WD-10 (mg/kg)	Eastern Background (a) (mg/kg)	Western Background (b) (mg/kg)
Inorganics (mg/kg)					
Aluminum	6,000	2,800	12,000	6,000	12,000
Antimony	0 42	0 58	2 1	0.42	2 1
Arsenic	2.1	5 4	15	2 1	15
Barium	68	65	86	68	86
Beryllium	0 42	0.45	0 92	0 42	0 92
Cadmium	0 91	0 48	1 4	0 91	1 4
Calcium	1,900	18,000	5,500	1,900	18,000
Chromium	11	7.3	27	11	27
Cobalt	1 8	3 5	6 1	1 8	6.1
Copper	7.5	9 6	30	7.5	30
Iron	5,100	11,000	16,000	5,100	16,000
Lead	14	28	46	14	46
Magnesium	740	2,100	1,800	740	2,100
Manganese	130	480	100	130	480
Mercury	0 013	0.0093	0 057	0 013	0 057
Nickel	5	6 5	16	5	16
Potassium	720	320	1,200	720	1,200
Selenium	<0 49	<0.64	<1.1	ND	ND
Silver	<0 074	<0 1	<0.15	ND	ND
Sodium	<69	150	<96	ND	150
Vanadium	14	11	26	14	26
Zinc	460	310	920	460	920
Organics (µg/kg)					
2-Butanone	*NS*	*NS*	*NS*	ND	ND
Acetone	*NS*	*NS*	*NS*	ND	ND
cis-1,2-Dichloroethene	*NS*	*NS*	*NS*	ND	ND
trans-1,2-Dichloroethene	*NS*	*NS*	*NS*	ND	ND
Trichloroethylene	*NS*	*NS*	*NS*	ND	ND
Vinyl Chloride	*NS*	*NS*	*NS*	ND	ND

Notes.
NS Not sampled.
< The constituent was not detected at a concentration greater than the reported detection limit.
mg/kg Milligrams per kilogram
ND Not detected
µg/kg Micrograms per kilogram

(a) The eastern background is equal to the constituent concentration detected in the eastern background sample
(b) The western background is equal to the highest detected concentration for each constituent in the western samples

Table C-8c
Occurrence of Constituents In Background Soil
Eagle Zinc
Hillsboro, Illinois

Constituent	Counties Within Metropolitan Statistical Areas (a)	Counties Outside Metropolitan Statistical Areas (a)
Inorganics (mg/kg)		
Aluminum	9,500	9,200
Antimony	4	3 3
Arsenic	13	11.3
Barium	110	122
Beryllium	0.59	0 56
Cadmium	0 6	0.5
Calcium	9,300	5,525
Chromium	16.2	13
Cobalt	8 9	8 9
Copper	19 6	12
Iron	15,900	15,000
Lead	36	20.9
Magnesium	4,820	2,700
Manganese	636	630
Mercury	0.06	0 05
Nickel	18	13
Potassium	1,268	1,100
Sodium	130	130
Thallium	0 32	0.42
Vanadium	25 2	25
Zinc	95	60 2

Notes
mg/kg Milligrams per kilogram

(a) Illinois Administrative Code Title 35· Environmental Protection, Part 742 Tiered Approach To Corrective Action Objectives, Chapter I· Pollution Control Board, Section 742. Appendix A General, Section 742 Table G Concentrations Of Inorganic Chemicals In Background Soils.
http //www legis.state.il us/commission/jcar/admincode/035/03500742ZZ9997agR html
Eagle Zinc is in a county outside a metropolitan statistical area

Table C-9a
Occurrence of Constituents in Surface Water (All Samples)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min - Max (mg/L)	Range of Detects Min - Max (mg/L)	UCL (mg/L)	EPC (mg/L)	
Inorganics						
Aluminum	5 / 12	0 027 - 0 076	0.031 - 1 4	0.38	0 38	u
Antimony	3 / 12	0.0025 - 0 0025	0 00026 - 0 00032	0 0017	0 00032	m
Arsenic	3 / 12	0 0081 - 0.0081	0 0012 - 0.0022	0 0048	0.0022	m
Barium	12 / 12		0 021 - 0 089	0 059	0 059	u
Beryllium	1 / 12	0 0001 - 0 00061	0.00018	0 00044	0 00018	m
Cadmium	11 / 12	0 00053	0 0012 - 0 23	1.3	0 23	m
Calcium	12 / 12		42 - 150	140	140	u
Chromium	4 / 12	0 00093 - 0.00093	0 00061 - 0 0018	0 00085	0 00085	u
Cobalt	7 / 12	0 0009 - 0.0009	0.00084 - 0 0024	0 0015	0.0015	u
Copper	12 / 12		0 0011 - 0.0049	0 0041	0 0041	u
Iron	12 / 12		0.056 - 3.2	1 8	1.8	u
Lead	7 / 12	0.0013 - 0.0013	0.0022 - 0.0052	0 0038	0.0038	u
Magnesium	12 / 12		14 - 38	35	35	u
Manganese	12 / 12		0 01 - 0.62	1	0 62	m
Mercury	1 / 12	0 00002 - 0.0002	0.00003	0 000031	0.00003	m
Nickel	12 / 12		0 0018 - 0.036	0.036	0.036	u
Potassium	12 / 12		3.6 - 17	11	11	u
Selenium	3 / 12	0 0048 - 0 0048	0 0014 - 0.002	0 0025	0 002	m
Silver	2 / 12	4.9E-05 - 0 0011	0 00006 - 0.00006	0 0018	0.00006	m
Sodium	12 / 12		15 - 60	55	55	u
Sulfate	9 / 9		130 - 450	420	420	u
Thallium	0 / 12	0.00012 - 0.0043	ND	ND	ND	
Vanadium	4 / 12	0.00084 - 0 00084	0.00065 - 0 0051	0 0013	0.0013	u
Zinc	12 / 12		0 71 - 26	75	26	m
Organics						
cis-1,2-Dichloroethene	2 / 5	8 1E-07 - 8 1E-07	0 000002 - 2.2E-06	0 0000089	0 0000022	m
Trichloroethylene	2 / 5	3.9E-07 - 3 9E-07	1.4E-06 - 6.3E-06	0.00077	0.0000063	m

Notes
EPC Exposure point concentration (rounded to two significant figures)
m The calculated UCL exceeds maximum concentration, the maximum concentration is the EPC
mg/L Milligrams per liter
ND Not detected
SQLs Sample quantitation limit
u The calculated UCL is less than maximum concentration; the UCL is the EPC.
UCL The 95 percent upper confidence limit on the mean (lognormal distribution) Gilbert, 1987.

Table C-9b
Occurrence of Constituents In Sediment (All Samples)
Eagle Zinc
Hillsboro, Illinois

Constituent	Frequency Detects / Total	Range of SQLs Min – Max (mg/kg)	Range of Detects Min – Max (mg/kg)	UCL (mg/kg)	EPC (mg/kg)	
Metals						
Aluminum	14 / 14		2,300 – 19,000	9,400	9,400	u
Antimony	13 / 14	0.45	0.48 – 12	4.5	4.5	u
Arsenic	14 / 14		2.4 – 25	9.3	9.3	u
Barium	14 / 14		30 – 190	90	90	u
Beryllium	14 / 14		0.27 – 1.1	0.66	0.66	u
Cadmium	14 / 14		0.83 – 550	2,400	550	m
Calcium	14 / 14		1,300 – 23,000	14,000	14,000	u
Chromium	14 / 14		5.9 – 26	15	15	u
Cobalt	14 / 14		1.2 – 14	11	11	u
Copper	14 / 14		4.8 – 320	170	170	u
Iron	14 / 14		5,100 – 45,000	24,000	24,000	u
Lead	14 / 14		20 – 2,700	1,000	1,000	u
Magnesium	14 / 14		760 – 5,400	3,000	3,000	u
Manganese	14 / 14		70 – 750	530	530	u
Mercury	13 / 14	0.0046	0.012 – 1.7	9.8	1.7	m
Nickel	14 / 14		4.2 – 29	24	24	u
Potassium	14 / 14		270 – 1,400	780	780	u
Selenium	3 / 14	0.44 – 0.73	1.1 – 1.4	0.7	0.7	u
Silver	8 / 14	0.066 – 0.1	0.089 – 2.4	1.7	1.7	u
Sodium	0 / 14	21 – 92	ND	ND	ND	
Vanadium	14 / 14		7.8 – 34	23	23	u
Zinc	14 / 14		400 – 23,000	41,000	23,000	m
Organics						
2-Butanone	2 / 2		0.0086 – 0.02	NA	0.02	m
Acetone	2 / 2		0.026 – 0.049	NA	0.049	m
cis-1,2-Dichloroethene	2 / 5	0.0012 – 0.0017	0.0041 – 0.086	700	0.086	m
trans-1,2-Dichloroethene	2 / 5	0.001 – 0.0014	0.0056 – 0.02	4.3	0.02	m
Trichloroethylene	2 / 5	0.0012 – 0.0017	0.003 – 0.0045	0.017	0.0045	m
Vinyl Chloride	2 / 5	0.0011 – 0.0015	0.0025 – 0.013	0.26	0.013	m

Notes
EPC Exposure point concentration (rounded to two significant figures)
m The calculated UCL exceeds maximum concentration; the maximum concentration is the EPC.
mg/kg Milligrams per kilogram
NA Not applicable
ND Not detected
SQLs Sample quantitation limit
u The calculated UCL is less than maximum concentration; the UCL is the EPC
UCL The 95 percent upper confidence limit on the mean (lognormal distribution). Gilbert, 1987

APPENDIX D

FOOD WEB EVALUATION DETAIL

Table D-1a
Piscivorous Wildlife Water/Dietary NOAELs and LOAELs
Eagle Zinc
Hillsboro, Illinois

	Mink (Piscivore) (a) NOAEL (mg/L)	Mink (Piscivore) (a) LOAEL (mg/L)	Great Blue Heron (Piscivore) (a) NOAEL (mg/L)	Great Blue Heron (Piscivore) (a) LOAEL (mg/L)
Metals				
Aluminum	0 025	0 253	2.699	---
Antimony	0 22	2 204	---	---
Arsenic	0.022	0.216	1.695	4.235
Barium	---	---	---	---
Beryllium	0.188	---	---	---
Cadmium	0.0004367	0 004367	0 001	0 009
Calcium	---	---	---	---
Chromium	4.947	19 817	---	---
Cobalt	---	---	---	---
Copper	0.294	0.387	0 921	1.21
Iron	---	---	---	---
Lead	0.982	9 823	0.142	1.421
Magnesium	---	---	---	---
Manganese	---	---	---	---
Mercury	0 000003924	0 00000654	0.000001305	0.00001305
Nickel	2 104	4.209	4.145	5.731
Potassium	---	---	---	---
Selenium	0.0004318	0.0007124	0 001094	0 002188
Silver	---	---	---	---
Sodium	---	---	---	---
Sulfate	---	---	---	---
Thallium	0.001	0 012	---	---
Vanadium	---	---	---	---
Zinc	0 929	1 858	0.085	0.771
Organics				
cis-1,2-Dichloroethene	---	---	---	---
Trichloroethylene	---	---	---	---

Notes
--- Not available.
LOAEL Lowest Observed Apparent Effects Level
mg/L Milligrams per liter.
NOAEL No Observed Apparent Effects Level.

(a) Sample, 1996 Toxicological Benchmarks for Wildlife: 1996 Revision.

Table D-1b
Mammalian Toxicity Reference Values for Bioaccumulative COPCs in Surface Soil
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	TOXICITY DATA (b) Chronic NOAEL (mg/kg BW-day)	Chronic LOAEL (mg/kg BW-day)	Test Species	Body Weight of Test Species (kg)	Test Type	Duration	Effect	Deer Mouse RTVs (c) Chronic NOAEL (mg/kg BW-day)	Chronic LOAEL (mg/kg BW-day)
Metals									
Arsenic	0.126	1 26	Mouse	0 03	Oral in water	3 generations	Reproduction	0 15	1 38
Cadmium	1	10	Rat	0 303	Oral gavage	6 weeks	Reproduction	2.12	19.5
Chromium	2,737	NA	Rat	0 35	Oral in diet	2 years and 3 months	Reproduction, longevity	6,020	---
Copper	11.7	15 14	Mink	1	Oral in diet	357 days	Reproduction	33 4	39 8
Lead	8	80	Rat	0 35	Oral in diet	3 generations	Reproduction	17.6	162
Mercury	1	NA	Mink	1	Oral in diet	6 months	Reproduction	2.86	---
Nickel	40	80	Rat	0.35	Oral in diet	3 generations	Reproduction	87.9	162
Selenium	0.2	0 33	Rat	0 35	Oral in water	1 year	Reproduction	0.44	0 667
(d) Silver	22	222	Rat	0 35	Oral in water	37 weeks	Decreased weight gain	48.8	449
Zinc	160	320	Rat	0.35	Oral in diet	Days 1 -16 of gestation	Reproduction	352	647

Notes:

---	Not available.	LOAEL	Lowest Observed Adverse Effect Level
BW	Body weight.	mg	Milligrams.
COPC	Constituent of Potential Concern	NOAEL	No Observed Adverse Effect Level
kg	Kilograms.	RTV	Reference toxicity value normalized for differences in body weight

(a) Only those constituents identified as bioaccumulative COPCs in USEPA 2000, "Bioaccumulation Testing And Interpretation For The Purpose Of Sediment Quality Assessment" are included

(b) Sample, 1996. Toxicological Benchmarks for Wildlife, except for silver (which is from ATSDR)

(c) RTVs were normalized for bodyweight differences between the test animal and the deer mouse The NOAELs were normalized to the maximum scenario bodyweight, and the LOAELs were normalized to the refined scenario bodyweight *(See Table D-2a)*

(d) ATSDR (Agency for Toxic Substances and Disease Registry), 1987-1994

Table D-1c
Avian Toxicity Reference Values for Bioaccumulative COPCs in Surface Soil
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	Chronic NOAEL (mg/kg BW-day)	Chronic LOAEL (mg/kg BW-day)	TOXICITY DATA (b) Test Species	Test Type	Duration	Effect
Metals						
Arsenic	2.46	7 38	Brown-headed Cowbird	Oral in diet	7 months	Mortality
Cadmium	1.45	20	Mallard Ducks	Oral in diet	90 days	Reproduction
Chromium	1	5	Black duck	Oral in diet	10 months	Reproduction
Copper	47	61 7	1 day old chicks	Oral in diet	10 weeks	Growth, mortality
Lead	3 85	NA	American Kestrel	Oral in diet	7 months	NOAEL for reproductive effects
Mercury	0.45	0 9	Japanese Quail	Oral in diet	1 year	Reproduction
Nickel	77.4	107	Mallard duckling	Oral in diet	90 days	NOAEL for mortality, growth, behavior effects
Selenium	0.5	1	Mallard duck	Oral in diet	78 days	Reproduction
(c) Silver	17	42	Average of other data.			
Zinc	14.5	131	White leghorn hen	Oral in diet	44 weeks	Reproduction

Notes

BW Body weight.
COPC Constituent of Potential Concern
kg Kilograms.
LOAEL Lowest Observed Adverse Effect Level
mg Milligrams.
NA Not available.
NOAEL No Observed Adverse Effect Level

(a) Only those constituents identified as bioaccumulative COPCs in USEPA 2000, "Bioaccumulation Testing And Interpretation For The Purpose Of Sediment Quality Assessment" are included
(b) Sample, 1996 Toxicological Benchmarks for Wildlife
(c) No toxicity data was available for silver, so the values represent an average value of the avalalable data.

Table D-2a
Deer Mouse Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

Deer Mouse Exposure (a)

$$\text{Deer Mouse Exposure} = \text{SFF x EF x }[\text{Food Exposure} + \text{Soil Exposure} + \text{Water Exposure}]$$

Where:
Deer Mouse Exposure = Oral intake of constituent (mg/kg-d)
SFF = Site Foraging Frequency (unitless percentage) (literature)
EF = Exposure Frequency (unitless percentage) (literature)

Food Exposure (a)

$$\text{Food Exposure}\left(\frac{mg}{kg-d}\right) = \left[\frac{FIR_{inv} \times C_{inv}}{BW}\right] + \left[\frac{FIR_{plant} \times C_{plant}}{BW}\right]$$

Where:
FE = Exposure to constituent attributed to food (mg COPC /kg body weight/day)
FIR_{inv} = Fractional ingestion rate (kg fresh weight of invertebrates/individual/day) for invertebrates (calculated)
C_{inv} = Concentration of constituent in invertebrates (mg COPC/kg fresh weight invertebrates) (calculated)
BW = Body weight of deer mouse (kg) (literature)
FIR_{plant} = Fractional ingestion rate (kg fresh weight of plants/individual/day) for plants (calculated)
C_{plant} = Concentration of constituent in plants (mg COPC/kg fresh weight of plants) (calculated)

Plant and Invertebrate Ingestion (a)

$$FIR_{inv} = P_{inv} \times IR_f \qquad FIR_{plants} = P_{plants} \times IR_f$$

Where:
FIR_{inv} = Fractional ingestion rate for invertebrates (kg dry weight invertebrates/individual/day)
P_{inv} = Proportion of invertebrates in the diet (unitless percentage) (literature)
IR_f = total food ingestion rate (kg dry weight/individual/day) (calculated using allometric equation)
FIR_{plants} = Fractional ingestion rate for plants (kg dry weight of plants/individual/day)
P_{plants} = Proportion of plants in the diet (unitless percentage) (literature)

Rodent Ingestion Rate for Food (b)

$$IR_f = \frac{0.621x\left(BW^{0.564}\right)}{1000\frac{mg}{kg}}$$

Where:
IR_f = Total food ingestion rate (kg dry weight/individual/day)
BW = Body weight of deer mouse (g) (literature)

Table D-2a
Deer Mouse Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

Plant and Invertebrate COPC Concentrations (c, d)

$$C_{inv} = C_{soil} \times UF_{inv} \qquad C_{plants} = C_{soil} \times UF_{plants}$$

Where:

C_{inv} = Concentration of COPC in invertebrates (mg COPC/kg dry weight invertebrates)

C_{soil} = Concentration of COPC in soil (mg COPC/kg dry weight soil) (from data)

UF_{inv} = Constituent-specific uptake factor from soil to invertebrates ((mg COPC/kg dry weight tissue)/(mg COPC/kg dry weight soil)) (literature)

C_{plants} = Concentration of COPC in plants (mg COPC/kg dry weight plants)

UF_{plants} = Constituent-specific uptake factor from soil to plants ((mg COPC/kg dry weight tissue)/(mg COPC/kg dry weight soil)) (literature)

Soil Exposure (a)

$$\text{Soil Exposure}\left(\frac{mg}{kg-d}\right) = \left[\frac{IR_{soil} \times C_{soil}}{BW}\right]$$

Where.

Soil Exposure = Exposure to constituent attributed to soil consumption (mg/kg/d)

IR_{soil} = Ingestion rate of soil (kg/individual/day) (literature)

C_{soil} = Concentration of constituent in soil (mg/kg, dry weight) (from data)

BW = Body weight of deer mouse (kg) (literature)

Water Exposure (a)

$$\text{Water Exposure}\left(\frac{mg}{kg-d}\right) = \left[\frac{IR_{water} \times C_{water}}{BW}\right]$$

Where

Water Exposure = Exposure to constituent attributed to water consumption (mg/kg/d)

IR_{water} = Ingestion rate of water (L/individual/day) (allometric equation)

C_{water} = Concentration of constituent in water (mg/L) (from data)

BW = Body weight of deer mouse (kg) (literature)

Ingestion Rate for Water (b)

$$IR_W = 0.099 \times \left(BW^{0.9}\right)$$

Where:

IR_w = Water ingestion rate (liters/individual/day)

BW = Body weight of deer mouse (kg) (literature)

Total Equation

$$\text{Deer Mouse Exposure} = SFF \times EF \times \left[\left[\frac{FIR_{inv} \times C_{inv}}{BW}\right] + \left[\frac{FIR_{plant} \times C_{plant}}{BW}\right] + \left[\frac{IR_{soil} \times C_{soil}}{BW}\right] + \left[\frac{IR_{water} \times C_{water}}{BW}\right]\right]$$

Table D-2a
Deer Mouse Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

This equation generates a level of deer mouse oral exposure in (mg/kg-d). The exposure level is then compared to a laboratory toxicity study to determine if there are likely to be effects on the deer mice. However, as the laboratory studies use other small mammals (rats, mice, minks) the NOAEL (no observed apparent effects level) and the LOAEL (lowest observed apparent effects level) from the laboratory study must be normalized for the differences in body weight.

Scaling Toxicity Values for Body Weight (a)

$$NOAEL_{\text{deer mouse}} = NOAEL_{\text{lab animal}} \left(\frac{BW_{\text{lab animal}}}{BW_{\text{deer mouse}}} \right)^{1/4}$$

Where:

$NOAEL_{\text{deer mouse}}$ = The toxicity reference value (TRV) used for comparison to the exposure estimate for the deer mouse (mg/kg-d).

$NOAEL_{\text{lab animal}}$ = The reported value from the study (mg/kg-d) (literature)

$BW_{\text{lab animal}}$ = The body weight of the lab animal from the study (kg) (literature)

$BW_{\text{deer mouse}}$ = The body weight of the deer mouse (kg) (literature)

$$LOAEL_{\text{deer mouse}} = LOAEL_{\text{lab animal}} \left(\frac{BW_{\text{lab animal}}}{BW_{\text{deer mouse}}} \right)^{1/4}$$

Where:

$LOAEL_{\text{deer mouse}}$ = The toxicity reference value (TRV) used for comparison to the exposure estimate for the deer mouse (mg/kg-d)

$LOAEL_{\text{lab animal}}$ = The reported value from the study (mg/kg-d) (literature)

$BW_{\text{lab animal}}$ = The body weight of the lab animal from the study (kg) (literature)

$BW_{\text{deer mouse}}$ = The body weight of the deer mouse (kg) (literature)

Hazard Quotient (a)

$$HQ_{\text{deer mouse}} = \left(\frac{\text{Deer Mouse Exposure}}{TRV_{\text{deer mouse}}} \right)$$

Where:

HQ = The unitless ratio of the deer mouse exposure to the toxicity reference value, rounded to one significant digit (unitless).

Deer Mouse Exposure = Oral intake of constituent (mg/kg-d) (calculated)

$TRV_{\text{deer mouse}}$ = The body-weight-normalized toxicity reference value (mg/kg-d) (calculated)

(a) 1994 Sample & Suter Estimating Wildlife Exposure to Contaminants.
(b) 1993 Wildlife Exposure Handbook
(c) 1998 Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants Bechtel Jacobs Company LLC
(d) 1998 Development and Validation of Bioaccumulation Models for Earthworms. Sample, Beauchamp, Efroymson, Suter II and Ashwood

Table D-2b
American Robin Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

American Robin Exposure (a)

$$\text{American Robin Exposure} = \text{SFF} \times \text{EF} \times [\text{Food Exposure} + \text{Soil Exposure} + \text{Water Exposure}]$$

Where:

American Robin Exposure = Oral intake of constituent (mg/kg-d)

SFF = Site Foraging Frequency (unitless percentage) (literature)

EF = Exposure Frequency (unitless percentage) (literature)

Food Exposure (a)

$$\text{Food Exposure}\left(\frac{mg}{kg-d}\right) = \left[\frac{FIR_{inv} \times C_{inv}}{BW}\right] + \left[\frac{FIR_{plant} \times C_{plant}}{BW}\right]$$

Where:

FE = Exposure to constituent attributed to food (mg COPC /kg body weight/day)

FIR_{inv} = Fractional ingestion rate (kg fresh weight of invertebrates/individual/day) for invertebrates (calculated).

C_{inv} = Concentration of constituent in invertebrates (mg COPC/kg fresh weight invertebrates) (calculated)

BW = Body weight of American Robin (kg) (literature)

FIR_{plant} = Fractional ingestion rate (kg fresh weight of plants/individual/day) for plants (calculated)

C_{plant} = Concentration of constituent in plants (mg COPC/kg fresh weight of plants) (calculated)

Plant and Invertebrate Ingestion (a)

$$FIR_{inv} = P_{inv} \times IR_f \qquad FIR_{plants} = P_{plants} \times IR_f$$

Where:

FIR_{inv} = Fractional ingestion rate for invertebrates (kg dry weight invertebrates/individual/day)

P_{inv} = Proportion of invertebrates in the diet (unitless percentage) (literature)

IR_f = total food ingestion rate (kg dry weight/individual/day) (calculated using allometric equation)

FIR_{plants} = Fractional ingestion rate for plants (kg dry weight of plants/individual/day)

P_{plants} = Proportion of plants in the diet (unitless percentage) (literature)

Passerine Ingestion Rate for Food (b)

$$IR_f = \frac{(0.0398 \times (BW^{0.85}))}{1000\frac{mg}{kg}}$$

Where:

IR_f = Total food ingestion rate (kg dry weight/individual/day)

BW = Body weight of American Robin (g) (literature)

Table D-2b
American Robin Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

Plant and Invertebrate COPC Concentrations (c, d)

$$C_{inv} = C_{soil} \times UF_{inv} \qquad C_{plants} = C_{soil} \times UF_{plants}$$

Where

C_{inv} = Concentration of COPC in invertebrates (mg COPC/kg dry weight invertebrates)
C_{soil} = Concentration of COPC in soil (mg COPC/kg dry weight soil) (from data)
UF_{inv} = Constituent-specific uptake factor from soil to invertebrates ((mg COPC/kg dry weight tissue)/(mg COPC/kg dry weight soil)) (literature)
C_{plants} = Concentration of COPC in plants (mg COPC/kg dry weight plants)
UF_{plants} = Constituent-specific uptake factor from soil to plants ((mg COPC/kg dry weight tissue)/(mg COPC/kg dry weight soil)) (literature)

Soil Exposure (a)

$$\text{Soil Exposure}\left(\frac{mg}{kg-d}\right) = \left[\frac{IR_{soil} \times C_{soil}}{BW}\right]$$

Where:
Soil Exposure = Exposure to constituent attributed to soil consumption (mg/kg/d)
IR_{soil} = Ingestion rate of soil (kg/individual/day) (literature)
C_{soil} = Concentration of constituent in soil (mg/kg, dry weight) (from data)
BW = Body weight of American Robin (kg) (literature)

Water Exposure (a)

$$\text{Water Exposure}\left(\frac{mg}{kg-d}\right) = \left[\frac{IR_{water} \times C_{water}}{BW}\right]$$

Where
Water Exposure = Exposure to constituent attributed to water consumption (mg/kg/d)
IR_{water} = Ingestion rate of water (L/individual/day) (allometric equation)
C_{water} = Concentration of constituent in water (mg/L) (from data)
BW = Body weight of American Robin (kg) (literature)

Ingestion Rate for Water (b)

$$IR_w = 0.059 \times \left(BW^{0.67}\right)$$

Where:
IR_w = Water ingestion rate (liters/individual/day)
BW = Body weight of American Robin (kg) (literature)

Total Equation

$$\text{American Robin Exposure} = SFF \times EF \times \left[\left[\frac{FIR_{inv} \times C_{inv}}{BW}\right] + \left[\frac{FIR_{plant} \times C_{plant}}{BW}\right] + \left[\frac{IR_{soil} \times C_{soil}}{BW}\right] + \left[\frac{IR_{water} \times C_{water}}{BW}\right]\right]$$

Hazard Quotient (a)

$$HQ_{\text{American Robin}} = \left(\frac{\text{American Robin Exposure}}{TRV_{\text{American Robin}}}\right)$$

Where
HQ = The unitless ratio of the American Robin exposure to the toxicity reference value, rounded to one significant digit (unitless).
American Robin Exposure = Oral intake of constituent (mg/kg-d) (calculated)
TRV American Robin = The body-weight-normalized toxicity reference value (mg/kg-d) (calculated)

Table D-2b
American Robin Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

(a) 1994 Sample & Suter Estimating Wildlife Exposure to Contaminants

(b) 1993 Wildlife Exposure Handbook

(c) 1998 Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants Bechtel Jacobs Company LLC

(d) 1998 Development and Validation of Bioaccumulation Models for Earthworms Sample, Beauchamp, Efroymson, Suter II and Ashwood

Table D-2c
Red-Tailed Hawk Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

Red-Tailed Hawk Exposure (a)

$$\text{Red - Tailed Hawk Exposure} = \text{SFF} \times \text{EF} \times \left[\text{Food Exposure} + \text{Soil Exposure} + \text{Water Exposure}\right]$$

Where:

Red-Tailed Hawk Exposure = Oral intake of constituent (mg/kg-d)

SFF = Site Foraging Frequency (unitless percentage) (literature)

EF = Exposure Frequency (unitless percentage) (literature)

Food Exposure (a)

$$\text{Food Exposure}\left({}^{mg}\!/_{kg-d}\right) = \left[\frac{FIR_{mammal} \times C_{mammal}}{BW}\right]$$

Where:

FE = Exposure to constituent attributed to food (mg COPC /kg body weight/day)

FIR_{mammal} = Fractional ingestion rate (kg fresh weight of mammals/individual/day) for mammals (calculated)

C_{mammal} = Concentration of constituent in mammals (mg COPC/kg fresh weight mammals) (calculated)

Mammal Ingestion (a)

$$FIR_{mammal} = P_{mammal} \times IR_f$$

Where:

FIR_{inv} = Fractional ingestion rate for invertebrates (kg dry weight invertebrates/individual/day)

P_{inv} = Proportion of invertebrates in the diet (unitless percentage) (literature)

IR_f = total food ingestion rate (kg dry weight/individual/day) (calculated using allometric equation)

FIR_{plants} = Fractional ingestion rate for plants (kg dry weight of plants/individual/day)

P_{plants} = Proportion of plants in the diet (unitless percentage) (literature)

Avian Ingestion Rate for Food (b)

$$IR_f = \frac{\left(0.301 \times \left(BW^{0.751}\right)\right)}{1000\,\frac{mg}{kg}}$$

Where:

IR_f = Total food ingestion rate (kg dry weight/individual/day)

BW = Body weight of Red-Tailed Hawk (g) (literature)

Table D-2c
Red-Tailed Hawk Food Web Modeling Overview
Eagle Zinc
Hillsboro, Illinois

Mammal COPC Concentrations (c)

$$C_{mammal} = C_{soil} \times UF_{mammal}$$

Where.

C_{mammal} = Concentration of COPC in mammals (mg COPC/kg dry weight mammals)

C_{soil} = Concentration of COPC in soil (mg COPC/kg dry weight soil) (from data)

UF_{mammal} = Constituent-specific uptake factor from soil to mammals ((mg COPC/kg dry weight tissue)/(mg COPC/kg dry weight soil)) (literature)

Water Exposure (a)

$$\text{Water Exposure}\left(\frac{mg}{kg-d}\right) = \left[\frac{IR_{water} \times C_{water}}{BW}\right]$$

Where:

Water Exposure = Exposure to constituent attributed to water consumption (mg/kg/d)

IR_{water} = Ingestion rate of water (L/individual/day) (allometric equation)

C_{water} = Concentration of constituent in water (mg/L) (from data)

BW = Body weight of Red-Tailed Hawk (kg) (literature)

Ingestion Rate for Water (b)

$$IR_w = 0.059 \times \left(BW^{0.67}\right)$$

Where:

IR_w = Water ingestion rate (liters/individual/day)

BW = Body weight of Red-Tailed Hawk (kg) (literature)

Total Equation

$$\text{Red-TailedHawk Exposure} = SFF \times EF \times \left[\left[\frac{FIR_{mammal} \times C_{mammal}}{BW}\right] + \left[\frac{IR_{water} \times C_{water}}{BW}\right]\right]$$

Hazard Quotient (a)

$$HQ_{\text{Red-Tailed Hawk}} = \left(\frac{\text{Red-TailedHawk Exposure}}{TRV_{\text{Red-Tailed Hawk}}}\right)$$

Where:

HQ = The unitless ratio of the Red-Tailed Hawk exposure to the toxicity reference value, rounded to one significant digit (unitless).

Red-Tailed Hawk Exposure = Oral intake of constituent (mg/kg-d) (calculated)

TRV Red-Tailed Hawk = The body-weight-normalized toxicity reference value (mg/kg-d) (calculated)

(a) 1994 Sample & Suter Estimating Wildlife Exposure to Contaminants

(b) 1993 Wildlife Exposure Handbook

(c) 1998 Development and Validation of Bioaccumulation Models for Small Mammals. Sample, Beauchamp, Efroymson, Suter II

Table D-3a
Deer Mouse Exposure Parameters
Eagle Zinc
Hillsboro, Illinois

Exposure Parameter	**Description**	**Values Selected for Exposure and Risk Calculations**
Deer Mouse	Order: Rodentia Family: Muridae Genus: Peromscus Species: maniculatus	
Body Weight (BW) (kg)	The maximum scenario uses the smallest reported adult body weight The refined scenario uses the average reported adult body weight	Maximum Scenario 0.015 kg (a) Refined Scenario 0 021 kg (a)
Dietary Makeup	The maximum scenario diet represents the diet that has the highest yearly average consumption of invertebrates The refined scenario presents the average of the yearly averages for three diet studies.	Maximum Scenario (a): Invertebrates – 56% Plant Material – 44% Refined Scenario (a). Invertebrates – 41% Plant Material – 59%
Ingestion Rate for Food (IRf) (kg dry weight/day)	Based on the allometric equation for rodents The maximum food ingestion rate is calculated using a maximum body weight of 0 030 kg, and the refined food ingestion rate is calculated using the average body weight (above) See Table D-2afor the allometric equation.	Maximum Scenario (a) 0.0072 kg dry wt/animal/day Refined Scenario (a) 0 0035 kg dry wt/animal/day
Ingestion Rate for Water (IRw) (l/day)	Based on the allometric equation for rodents The maximum water ingestion rate is calculated using a maximum body weight of 0 030 kg, and the refined water ingestion rate is calculated using the average body weight (above). See Table D-2afor the allometric equation.	Maximum Scenario (a) 0 0056 L/day Refined Scenario (a). 0.0031 L/day
Ingestion Rate for Soil (IRs) (kg dry weight/day)	This value is for the white footed mouse (*Peromyscus leucopus*) which is similar to the deer mouse.	0.000068 kg/d (b)
Home Range	Average of reported studies.	0 615 ha (1 5197 acres) (a)
Site Foraging Frequency (SFF) (unitless)	The SFF is the ratio of the site area to the home range, not to exceed a maximum value of 1 The robins are assumed to forage exclusively on the site.	SFF=1
Exposure Frequency	Deer mice are year-round residents at the site.	EF=1

(a) 1993 Wildlife Exposure Handbook
(b) 1994 Sample & Suter Estimating Wildlife Exposure to Contaminants.

Table D-3b
American Robin Exposure Parameters
Eagle Zinc
Hillsboro, Illinois

Exposure Parameter	Description	Values Selected for Exposure and Risk Calculations
American Robin	Order: Passeriformes Family Turdidae Genus Turdus Species migratorius	
Body Weight (BW) (kg)	Maximum scenario body weight is the lowest reported weight in reference a and the recommended body weight used in reference b. The refined scenario body weight is the average weight reported of adults in reference a	Maximum Scenario (a,b) 0 077 kg Refined Scenario (a) 0 081 kg
Dietary Makeup	The maximum scenario diet represents during the consumption of earthworms during the spring breeding season This scenario will overestimate the risk, as it typifies only a fraction of the yearly diet of the robins The refined scenario presents an average of the four diets presented in reference b The refined scenario will more adequately describe the chronic, year-round exposure of the robins	Maximum Scenario (b) Invertebrates – 93% Plant Material – 7% Refined Scenario (b) Invertebrates – 38% Plant Material – 62%
Ingestion Rate for Food (IRf) (kg dry weight/day)	Based on the allometric equation for passerine birds The maximum food ingestion rate is calculated using a maximum body weight of 0.100 kg, and the refined food ingestion rate is calculated using the average body weight (above) See Table D-2bfor the allometric equation	Maximum Scenario (a): 0.020 kg dw/day Refined Scenario (a) 0.017 kg dw/day
Ingestion Rate for Water (IRw) (l/day)	Based on the allometric equation for birds. The maximum water ingestion rate is calculated using a maximum body weight of 0.100 kg, and the refined water ingestion rate is calculated using the average body weight (above). See Table D-2bfor the allometric equation.	Maximum Scenario. 0 013 L/day (b) Refined Scenario. 0 011 L/day (a)
Ingestion Rate for Soil (IRs) (kg dry weight/day)	Recommended value.	0 0019 kg/d (b)
Home Range	Recommended value	0 42 ha (1 04 acres) (b)
Site Foraging Frequency (SFF) (unitless)	The SFF is the ratio of the site area to the home range, not to exceed a maximum value of 1. The robins are assumed to forage exclusively on the site	SFF=1
Exposure Frequency (EF) (unitless)	Most robins nesting in the northern United States and Canada winter in the Gulf Coast States and the Carolinas. Wintering robins are most abundant between 30 and 35 degrees N latitude. Robin flocks migrate during the day; most northern robins leave their breeding grounds from September to November and return between February and April USEPA, 1993 Wildlife Exposure Factors Handbook. In the maximum scenario, the robins are assumed to spend all of their time on the site (and to not migrate) In the refined scenario, the robins are assumed to spend 50% of their time on the site.	Maximum Scenario: EF=1 Refined Scenario EF=0.5

(a) 1993 Wildlife Exposure Handbook
(b) 1994 Sample & Suter Estimating Wildlife Exposure to Contaminants.

Table D-3c
Red-Tailed Hawk Exposure Parameters
Eagle Zinc
Hillsboro, Illinois

Exposure Parameter	Description	Values Selected for Exposure and Risk Calculations
Red-Tailed Hawk	Order: Falconiformes Family. Accipitridae Genus: Buteo Species: jamaicensis	
Body Weight (BW) (kg)	Maximum scenario body weight is the lowest reported weight in reference a. The refined scenario body weight is the average of adult body weights	Maximum Scenario 0 957 kg (a) Refined Scenario: 1.134 kg (a)
Dietary Makeup	The diet may range between roughly 80% mammals to 80% birds (a,b). This effort will assume that the hawks eat 100% mammals. However, the BCFs for the mammals show different sensitivities when comparing "general" mammals, versus insectivores, herbivores, and omnivores. The maximum scenario will use the most sensitive (highest) BCF of these four groups The refined scenario will use a diet composed of one-quarter each of general mammals, insectivores, herbivores, and omnivores.	Maximum Scenario (a) 100% Most sensitive mammal Refined Scenario (a): 25% General Mammals 25% Insectivores 25% Herbivores 25% Omnivores
Ingestion Rate for Food (IRf) (kg dry weight/day)	Based on the allometric equation for non-passerine birds. The maximum food ingestion rate is calculated using a maximum body weight of 1 500 kg, and the refined food ingestion rate is calculated using the average body weight (above) See Table D-2cfor the allometric equation	Maximum Scenario (a) 0.073 kg dw/day Refined Scenario (a) 0.059 kg dw/day
Ingestion Rate for Water (IRw) (l/day)	Based on the allometric equation for birds The maximum water ingestion rate is calculated using a maximum body weight of 1.500 kg, and the refined water ingestion rate is calculated using the average body weight (above) See Table D-2cfor the allometric equation.	Maximum Scenario (a) 0 077 L/day Refined Scenario (a) 0 064 L/day
Ingestion Rate for Soil (IRs) (kg dry weight/day)	Recommended value	Negligible (b)
Home Range	Recommended value.	233 ha (576 acres) (b)
Site Foraging Frequency (SFF) (unitless)	The SFF is the ratio of the site area to the home range, not to exceed a maximum value of 1. The site is approximately 132 acres in size. Therefore, the ratio of the site area to the home range of the hawk is 0.57	Maximum Scenario. SFF=1 Refined Scenario SFF=0.57
Exposure Frequency	Northerly populations of red-tailed hawks may migrate (b) The maximum scenario will assume that the hawks are year-round residents of the site, and the refined scenario will assume that the hawks migrate away from the site for half of the year	Maximum Scenario EF=1 Refined Scenario: EF=0.5

(a) 1993 Wildlife Exposure Handbook
(b) 1994 Sample & Suter. Estimating Wildlife Exposure to Contaminants.

Table D-4
Uptake Factors for Bioaccumulative COPCs in Surface Soil
Eagle Zinc
Hillsboro, Illinois

Constituent (a)	UF_v (b)		UF_i (c)		UF_m (d) General		Insectivore		Herbivore		Omnivore		Most Sensitive	
	Median	90th %	Median	90th %	Median	90th %	Median	90th %	Median	90th %	Median	90th %	Median	90th %
<u>Metals</u>														
Arsenic	0 0375	1 103	0 224	0.523	0 0025	0 0149	0.0013	0 001	0 0042	0 016	0 0025	0.014	0 0042	0.016
Cadmium	0 586	3.25	7.708	40.69	0 3333	3 9905	2 105	7 017	0 1258	0 448	0.1217	0 462	2 105	7 017
Chromium	---	---	0 306	3 162	0.0846	0.3333	0 0815	0 095	0 0884	0 309	0 0699	0.349	0 0884	0 349
Copper	0 124	0 625	0 515	1 531	0 1963	1 045	0 7714	1 117	0 1086	1 29	0 1272	0.554	0 7714	1 29
Lead	0.0389	0 468	0.266	1 522	0 1054	0 2864	0.1601	0 339	0.0522	0 187	0 0659	0 286	0.1601	0.339
Mercury	0 652	5	1.693	20 625	0 0543	0 192	1 0457	1 046	0 0239	0 024	0.0543	0.13	1 0457	1 046
Nickel	0 018	1 411	1 059	4 73	0.2488	0.5891	0 3643	0 578	0 0513	0 898	0.1683	0.589	0.3643	0 898
Selenium	0 672	3 012	0 985	1.34	0 1619	1 1867	0.7241	0.813	NA	0.155	0 2062	1.263	0 7241	1.263
(e) Silver	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zinc	0 366	1 82	3 201	12.885	0.7717	2.6878	0 83277	2 90106	0 50429	2 31681	0.55772	2 78218	0.83277	2 90106

Notes:

--- Not available.
UF_v Uptake factor for vegetation
UF_i Uptake factor for invertebrates
UF_m Uptake factor for mammals.

(a) Only those constituents identified as bioaccumulative COPCs in USEPA 2000, "Bioaccumulation Testing And Interpretation For The Purpose Of Sediment Quality Assessment" are included
(b) Bechtel Jacobs Company LLC., 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants.
(c) Sampleet al , 1998 Development and Validation of Bioaccumulation Models for Earthworms
(d) Sample et al., 1998. Development and Validation of Bioaccumulation Models for Small Mammals.
(e) The above references have no uptake factors for silver, so a default value of 1 was used.